PB-213 341

The Beverage Container Problem

analysis and recommendations

Research Triangle Institute

prepared for

Environmental Protection Agency

SEPTEMBER 1972

Distributed By:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

EPA-R2-72-059
September 1972

Environmental Protection Technology Series

PB 213 341

The Beverage Container Problem

ANALYSIS AND RECOMMENDATIONS

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INFORMATION SERVICE
U S Department of Commerce
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Office of Research and Monitoring
U.S. Environmental Protection Agency
Washington, D.C. 20460

75'

201

BIBLIOGRAPHIC DATA SHEET

1. Report No. EPA-R2-72-059

2.

3. Recipient's Accession No. PB-213 341

4. Title and Subtitle

THE BEVERAGE CONTAINER PROBLEM
Analysis and Recommendations

5. Report Date September 1972

6.

7. Author(s) Research Triangle Institute

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

Research Triangle Institute
Research Triangle Park, North Carolina 27711

10. Program Element 1D2314

11. Contract No. 68-03-0038

12. Sponsoring Organization Name and Address

U.S. Environmental Protection Agency
National Environmental Research Center
Office of Research & Monitoring
Cincinnati, Ohio 45268

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts

This study includes 2 principle elements: (a) the analyses of 3 types of environmental concern that might be cited as the rationale for a beverage container policy, and (b) the analyses and evaluation of alternative governmental policies for beverage containers, and resulting recommendations. Three types of environmental dimensions to beverage containers were examined as possible bases for government action. These were: (a) the resource dimensions to beverage container production, especially nonrefillable containers, (b) the solid waste dimensions of discarded beverage containers, and (c) the amenities dimensions of littered beverage containers. We conclude that beverage containers are an environmental problem primarily because some consumers of beverages litter their empty containers rather than disposing of them properly.

17. Key Words and Document Analysis. 17a. Descriptors

*Containers, Resources, *Conservation, *Containerizing, Refuse, Consumption, Legislation, Economic analysis, Environmental engineering

17b. Identifiers/Open-Ended Terms

*Beverage containers, Consumption, Litter

17c. COSATI Field/Group 11 07, 13 04, and 14 01

18. Availability Statement

Release to public

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 201

22. Price $6.75/$0.95

FORM NTIS-35 (REV. 3-72)

THIS FORM MAY BE REPRODUCED

USCOMM-DC 14952-P72

EPA-R2-72-059
September 1972

THE
BEVERAGE CONTAINER PROBLEM
ANALYSIS AND RECOMMENDATIONS

by

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Contract No. 68-03-0038
Program Element 1D2314

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OFFICE OF RESEARCH AND MONITORING
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WASHINGTON, D.C. 20460

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FOREWORD

Man and his environment must be protected from the adverse effects of pesticides, radiation, noise and other forms of pollution, and the unwise management of solid waste. Efforts to protect the environment require a focus that recognizes the interplay between the components of our physical environment - air, water and land. The multidisciplinary programs of the National Environmental Research Centers provide this focus as they engage in studies of the effects of environmental contaminants on man and the biosphere and in a search for ways to prevent contamination and recycle valuable resources.

When we think of litter; when we think of public displeasure; when we think of citizen action programs, the empty beverage container is high on the list. This contract study, published by the National Environmental Research Center, Cincinnati, was undertaken to comprehensively examine the beverage container problem, analyze government policies, and recommend an alleviating course of action. We believe the information found here will prove interesting and informative to everyone concerned with solving this problem.

Andrew W. Breidenbach, Ph.D.
Director, National Environmental
Research Center, Cincinnati

ACKNOWLEDGMENT

This study of the environmental problems caused by beverage containers was prepared by the Research Triangle Institute, Research Triangle Park, North Carolina, pursuant to Contract No. 68-03-0038 with the Environmental Protection Agency. The statements, findings, conclusions, and recommendations presented in this report do not necessarily reflect the views of the Environmental Protection Agency.

The principal investigators were Paul F. Mulligan and Tayler H. Bingham (project manager). Alex Cole and Alvin Cruze contributed to the analysis of resource requirements and quantification of consumer demand respectively. Raymond Collins, Dr. Michael Rulison, and Dr. David LeSourd provided critical reviews of the study.

The authors have benefited greatly from the comments and suggestions of the EPA Project Officer, Richard H. Ongerth. In addition, Harry Freeman, Leander Lovell, Arsen Darnay, Joel Jacknow, Daniel Greathouse, and Haynes C. Goddard all of EPA provided critical reviews of earlier drafts of the study. Their contributions are also appreciated.

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AN ANALYSIS OF THE BEVERAGE CONTAINER PROBLEM
WITH RECOMMENDATIONS FOR GOVERNMENTAL POLICY

Chapter 1: INTRODUCTION AND SUMMARY

1.1 Public Concern Over Beverage Containers

Many individuals and groups in the United States today consider beer and soft drink containers to be a significant environmental problem. The many legislative proposals pending in, and laws already enacted by, Congress and State legislatures, and proposed and enacted ordinances by localities to control the use or disposal of these bottles and cans are evidence of public concern. Another indication of this concern is the voluntary cleanup campaigns of individuals and groups.

A review of the proposed legislation affecting beverage containers shows that over 350 bills have been introduced in Congress, in State legislatures, and to local jurisdictions. These proposals include provisions to prohibit some types of containers, require deposits on others, tax all containers, or establish study committees to deal with beverage containers.* Several of the bills introduced in the Congress have been the subject of hearings before both House and Senate subcommittees.

The intended purposes of the proposed legislation are: to reduce the number of littered beverage containers, to reduce the burden placed on solid waste collection and disposal by discarded beverage containers, and/or to conserve the natural resources devoted to making beverage containers.

The first law restricting beverage containers was passed by the State of Vermont in 1953. It banned nonrefillable† beer bottles in an effort to reduce their littering. More recently the State of Oregon and City [illegible]ie, Maryland, have both passed laws which require deposits on all beverage containers.

---

*See Appendix A for a listing of the pending legislation.

†The terms "nonrefillable" and "nonreturnable" in this report refer to "no deposit-no return", "one-way" bottles that are designed for a single sale.

The Vermont Law expired in 1957 and was not renewed because the volume of litter was unaffected. Both the Oregon and Bowie laws are being challenged in the courts. The results are being anxiously awaited by many other States and localities currently considering some action on the beverage container.

A recent study for the Environmental Protection Agency (EPA) described some of the major voluntary cleanup campaigns, noting that such campaigns have been occurring with greater frequency due to the current wave of environmental concern.[1] These campaigns have ranged in size from large efforts (e.g., the Keep America Beautiful Day) when more than two million people picked up litter along 200,000 miles of highways and streams and from 400,000 acres of public recreation areas, to small, local efforts by Scouts or neighbors. These campaigns, according to the study, have a current estimated annual value of about $100 million, valuing the donated labor and truck time at rates reflective of the average costs typically incurred by municipalities to collect litter.[2]

These legislative initiatives and voluntary efforts bear witness to a significant level of public concern about the problem of beverage containers. The exact rationale for government* action, however, is not as obvious.

1.2 Approach

The purpose of this study is to provide a comprehensive examination of the beverage container problem, an analysis of alternative governmental policies, and recommendations as to the best course of action for EPA to take to alleviate this problem.

In order to develop a workable definition of the beverage container problem, we have examined the nature of beverage containers, including their materials composition, distribution systems, and the consumer behavior associated with the disposition of the empty container. As documented in this report, beverage containers are primarily a problem because they are a large and very visible share of litter. Several alternative approaches were examined that might discourage the littering of beverage containers and/or provide a basis for coping with the littered container. Finally, recommendations as to the best course of action for EPA to follow on this problem are presented.

---

*The terms "government" or "governmental" unless otherwise modified mean the Federal, State, or local government.

The definition of beverage container used in this study is a bottle or can customarily used to package beer or soft drinks for retail sale. These containers are frequently littered and, as such, often are the object of public concern. Therefore, it is justified to analyze them separately from other elements in solid waste.

Like any study, this one has limitations. One drawback is that the approach is from a national perspective and, therefore, does not explicitly treat the regional variations in beverage consumption and containerization. Another limitation is the lack of quantitative data on many important factors and the uncertainty associated with the expected shifts in beverage containerization as a result of each policy considered. In many cases, where we would have preferred to use quantitative relationships, we were unable to due to lack of data. In these cases we have used, and documented, our judgment.

We believe that despite these limitations, this study, cautiously interpreted, can provide a useful basis for informed decisionmaking by EPA on the problem of beverage containers.

1.3 Summary of Findings

This study includes two principle elements:

(a) the analyses of three types of environmental concern that might be cited as the rationale for a beverage container policy, and

(b) the analyses and evaluation of alternative governmental policies for beverage containers, and resulting recommendations.

There is substantial public concern over beverage containers. The proper basis for a government policy on beverage containers, however, must be determined within the overall context of environmental problems of which the beverage container problem is just one. Three types of environmental dimensions to beverage containers were examined as possible bases for government action. These were:

(a) the resource dimensions to beverage container production, especially nonrefillable containers,

(b) the solid waste dimensions of discarded beverage containers, and

(c) the amenities dimensions of littered beverage containers.

We conclude that beverage containers are an environmental problem primarily because some consumers of beverages litter their empty containers rather than disposing of them properly. This creates social costs. To a lesser extent, beverage containers are a problem because they are a growing portion of the increasing amounts of solid waste that must be suitably collected and disposed of each year.

There are several reasons why beverage containers are not considered a resource problem. First, they constitute a relatively small use of steel and aluminum, about 2.0 and 5.6 percent respectively of 1969 national production of these materials. They also accounted for about 44.9 percent of all container glass production. All three materials have resource inputs which are fairly plentiful. Second, although it does appear that we would save some energy that is produced from our natural resources if we could shift back to a refillables-only system, the savings would not be significant as a percent of total national consumption. Even more importantly, to allocate resources on the basis of energy requirements alone ignores the utility that consumers may derive from the convenience of nonrefillable containers. The resource dimensions of beverage containers, therefore, have not been used to define the beverage container problem.

We estimate that discarded beer and soft drink containers represented about 3.6 percent of the weight of residential and commercial solid waste in 1969. Their share is probably increasing due to the rapid growth in beverage containerization and the shifts to nonrefillable bottles and cans. There is no satisfactory way, given current data, to estimate the impact of a small component of solid waste on total collection and disposal costs. However, when we allocate costs on a percent of weight basis, we see that the beverage container would have accounted for $93.3 million in 1969. Fractional reduction in the number of containers in solid waste would not have a significant impact on collection and disposal costs, unless these reductions were combined with reductions of other solid waste elements. For this reason, we do not believe that the beverage container contribution to solid waste should be the primary rationale for government intervention.

Beverage containers represent an important share of litter. On a national basis they probably make up at least 20 percent of the items littered along our roadsides and, because of their lack of degradability, at least 30 percent of the items typically collected. Since they are highly visible and remain so over a long period of time, their importance probably is understated when using a unit-count-measurement basis. Because of the increases in beverage consumption and shifts in containerization, the number of littered beverage containers may well increase at a rate close to 8 percent annually in the years ahead. It is the contribution of beverage containers to litter, that makes them the subject of special policy consideration.

On a share-of-littered-items basis, the public spent a minimum of $43 million in 1969 to collect littered beverage containers--almost 2 cents per littered container. If the countryside were made as litter-free as most would like it, the required more frequent litter collections would substantially raise the collection cost per container.

Littered beverage containers result in more than an economic cost, they also result in an unmeasurable esthetic cost. To some extent, all members of society have their quality of life reduced in a littered environment.

In order to make an informed decision about the most appropriate policy for resolving the beverage container problem, a common set of criteria was needed. The following criteria were suggested by EPA:

(a) The policy has predictable impacts on beverage prices, consumption, and containerization;

(b) The policy produces benefits in litter and solid waste reductions exceeding the costs in terms of prices, convenience, employment, investment, tax revenues, and personal income;

(c) The policy is equitable, by making those who litter beverage containers bear the social costs of the littered containers;

(d) The policy is easy to administer;

(e) The policy uses a market-type mechanism;

(f) The policy is broadly applicable to other elements in solid waste.

We examined 10 specific policies falling within the three broad approaches of (a) restrictions, (b) incentives, and (c) use of indirect influence.

We conclude that either a mandatory high deposit or a low tax, with the revenues being used for more frequent litter collections, could provide significant environmental benefits by reducing the number of visible littered containers. However, we favor the tax over the deposit as the most appropriate governmental policy because it is more predictable, less costly to consumers and producers, and easier to administer. The tax should reflect the average social costs of littered containers--perhaps 0.5 to 1.0 cent per container. It should be applied on a State level, using the administrative procedures already existing for the collection of beer excise taxes. The revenues from a 0.5-cent tax would have been an estimated $219 million nationally in 1969.

Chapter 2: RATIONALE OF A BEVERAGE CONTAINER POLICY

2.1 Introduction

The substantial public concern over the disposal of beverage containers may justify some action, but the proper basis for government policy must be determined within the overall context of environmental problems. The questions, therefore, are: What, if any, are the particular characteristics of beverage containers that justify singling them out from the many other components of solid waste? Are special regulations governing their production or use justified?

There are three types of environmental concern that might be cited as the bases for beverage container controls:

(a) Scarce resources must be conserved by eliminating unnecessary or excessive uses;

(b) The volume of solid waste is so great that efforts should be taken to reduce the amount being discarded;

(c) Littering is destructive of environmental amenities and the beverage container is an important part of litter.

This chapter provides an evaluation of each of these as a basis for a government policy on beverage containers.

2.2 Conservation of Resources

Beverage containers are frequently cited as representing a wasteful use of resources. It is argued that the trend toward increased use of refillable bottles and cans is increasing the demand for steel and glass without providing a proportionate increase in utility over that provided by refillable containers. Evaluation of this argument requires an examination of: the extent to which nonrefillables are being used, the impact on resource availability of the various types of containers, and the broader implications of a product-by-product approach to resource conservation.

2.2.1 Trends in Containerization and Consumption

In 1955, 37 percent of all the beer and 2 percent of all soft drink fillings* were in nonrefillable containers. By 1969, the amounts had risen to 68 and 38 percent, respectively. Assuming that current trends will continue, 80 percent of the beer and 70 percent of the soft drink fillings will be in nonrefillable containers by 1976 (Figures 1 and 2).*

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*Fillings are the number of units of beverages sold. They differ from containerization for refillable bottles since these containers are each used several times.

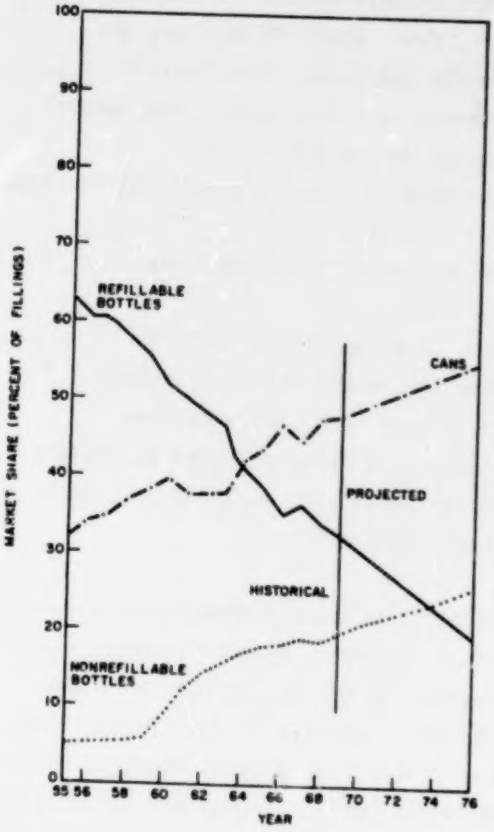

Figure 1. Beer container market share.

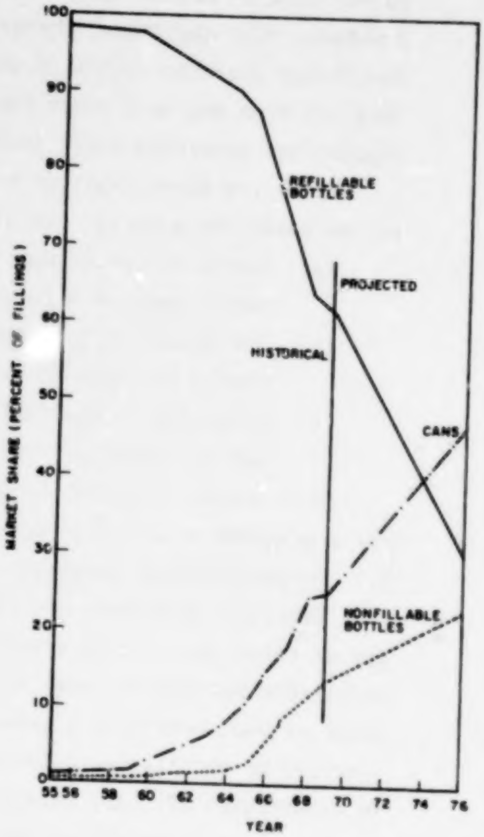

Figure 2. Soft drink container market share.

(Historical data from: Glass Containers Manufacturers Institute, and the Can Manufacturers Institute; projections by Research Triangle Institute--see Appendix B).

---

*See Appendix B for the development of these trends.

Based on the trends in beverage consumption, we project beverage containerization by 1976 to total about 101 billion fillings annually (see Figure 3); we project beverage container production to be about 77 billion then, compared to 46.9 billion containers in 1969 (Figure 4). The growth in containerization has been, and is expected to continue to be, more rapid than the growth in beverage consumption due to the decline in the market share of refillable containers. As a result, the ratio of beer and soft drink fillings to all containers manufactured continues to decline (Figure 5).*

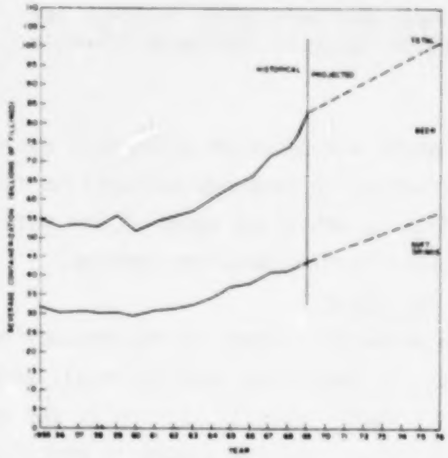

Figure 3. Beverage containerization.

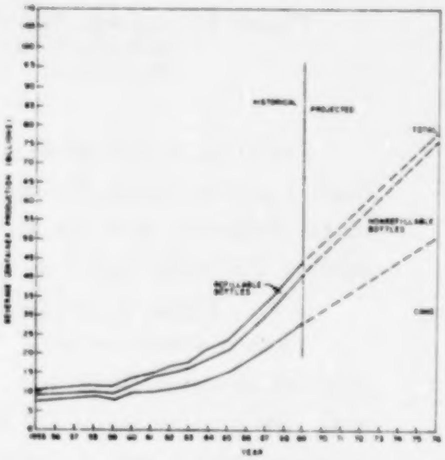

Figure 4. Beverage container production.

(Historical data from: Glass Containers Manufacturers Institute, and the Can Manufacturers Institute; projections by the Research Triangle Institute--see Appendix B).

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*See Appendix B for the discussion of the development of these trends.

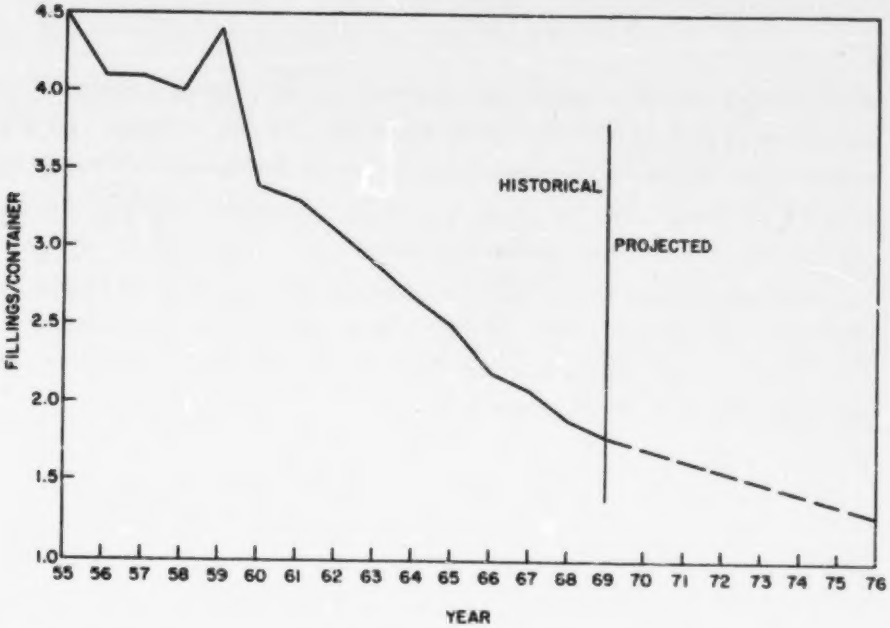

Figure 5. Average number of beer and soft drink fillings per container manufactured (Source: Research Triangle Institute).

The figures and trends cited above are based on a national average. There are significant regional variations in beverage consumption and containerization with the more affluent, urbanized areas of the nation leading the trend toward an all nonrefillable-container system.

2.2.2 Resource Implications for Glass

Table 1 shows the primary raw materials inputs in the production of glass beverage containers. Glass is made from sand (silica), soda ash, lime or limestone, and cullet (crushed glass). Silica is the most abundant constituent of the earth's crust, and its supply is practically inexhaustable.

Soda ash, the other main constituent of glass, is produced from a naturally occurring mineral (trona), complex brines, or through chemical processing of sodium. Trona is primarily found in Wyoming; the principal sources of the complex brines are Lake Owens and Searles Lake in California. Most of the soda ash is produced by the Solvay or

Table 1. ESTIMATED RAW MATERIALS USED TO PRODUCE GLASS AND GLASS BEVERAGE CONTAINERS, 1969

Material	Amounts used to produce all glass (thousand tons)	Amounts used to glass beverage containers (thousand tons)
Sand (silica)	10,520	4,726
Soda ash (Na_2CO_3)	2,893	1,300
Other (limestone, feldspar, etc.)	4,208	1,890
Cullet	132	59

Source: Inputs based on material adapted from Midwest Research Institute, Economic Study of Salvage Markets for Commodities Entering the Solid Waste Stream, Fig. 7.1, p. 7-12, December 1970; total glass production and glass beverage container production from Glass Containers Manufacturers Institute, Inc., Glass Containers, 1970.

ammonia soda process in plants near salt supplies. Supplies of both soda ash and limestone appear ample for all foreseeable uses. Cullet (recycled glass) is also readily available, through inplant generation and from scrap glass dealers.

2.2.3 Resource Implications for Steel

Table 2 shows the primary raw materials inputs in the production of steel beverage containers. The United States currently consumes 24 percent of the world's primary supply of steel, and produces 13 percent of the total.[4]

The iron content of the earth's crust is 5.6 percent, but only a fraction of this is concentrated in commercial deposits. There are an estimated 280,365 million tons of commercially exploitable iron ore reserves and 585,549 million tons of potential world reserves.[5] It is significant, however, that known world reserves increased threefold between 1954 and 1969. These deposits are sufficient to last hundreds of years at the present rate of consumption.[6]

Coal for heat energy is a major requirement in the production of steel. The U.S. and world reserves of coal indicate that the supply of coal should pose no problems for steel production. It is

Table 2. ESTIMATED RAW MATERIALS USED TO PRODUCE STEEL AND STEEL BEVERAGE CONTAINERS, 1969

Materials	Amounts used to produce all steel (thousand tons)	Amounts used to produce steel beverage containers (thousand tons)
Crude and concentrated iron ore	159,630	3,210
Coal	103,290	2,075
Lime, limestone, fluorspar, and other fluxes	32,865	660
Iron and steel scrap	30,518	615
Pig iron	11,738	235
Refractories clay and nonclay	4,695	95
Nonferrous metals, alloys and ferroalloys	2,348	45
Sulfuric acid (100% H_2SO_4)	1,174	25
Oxygen*	160,569,000,000 ft^3	3,225,000,000 ft^3

Source: Inputs based on material adapted from Bureau of the Census, 1967 Census of Manufactures, Industry Series, U.S. Department of Commerce, Washington, September 1969; total steel production from Annual Survey of Manufactures, 1969; steel beverage container production from Can Manufacturers Institute, Inc., Annual Report: Metal Can Shipments, 1969.

*Oxygen is measured in cubic feet.

estimated that world coal consumption for all purposes will be 2.0-3.5 million tons in the year 2000. There are an estimated 5 billion tons of coal reserves which should be extractable under current economic conditions.[7]

2.2.4 Resource Implications for Aluminum

Table 3 shows the primary raw materials inputs in the production of aluminum beverage containers. Aluminum is the most abundant metallic element in the earth's crust; its supply, for practical purposes, is limited only by demand. Current economic and technological conditions, however, essentially limit the commercial raw material to bauxite. Approximately 4 tons of bauxite are required to produce 1 ton of metallic aluminum. Bauxite is plentiful, although principal deposits

Table 3. ESTIMATED RAW MATERIALS USED TO PRODUCE ALUMINUM AND ALUMINUM BEVERAGE CONTAINERS, 1969

Material	Amounts used to produce all aluminum (thousand tons)	Amounts used to produce beverage containers (thousand tons)
Alumina	104,992.0	436.2
Cryolite	1,088.0	4.5
Aluminum fluoride	1,904.0	7.9
Fluorspar	163.2	0.7
Anode carbon	27,200.0	113.0
Cathode carbon	1,088.0	4.5
Electricity, a.c.	816 000,000 kW-h	3,390,000 kW-h

Source: Inputs based on material adapted from Mineral Facts and Problems, 1970, U.S. Department of the Interior, Bureau of Mines, Washington, D.C., p. 445; total aluminum production from Annual Survey of Manufactures, 1969; aluminum beverage container production from Can Manufacturers Institute, Inc., Annual Report: Metal Can Shipments, 1969.

are in tropical areas away from the main aluminum producing and consuming areas of the world. Known world reserves of bauxite (6.5 billion tons) would produce approximately 1.6 billion tons of aluminum, 145 times present annual world consumption.[8] Potential world reserves, which are deposits that are only partially explored or are marginal or submarginal under existing technology and economics, would produce an estimated 9.6 billion additional tons. Other potential sources of aluminum include ferruginous bauxite, bauxitic clay, kaolin and other aluminum-rich clays, anorthsite, the kyanite group of minerals, laterites, and shales. The clays, which are in large supply in the United States, could be firmly established as a basic aluminum source before the year 2000.[9] The supplies of materials that are required to produce aluminum apparently pose no serious problems.

In summary, as shown in Table 4, 5,908,000 tons of glass, 1,886,000 tons of steel, and 226,000 tons of aluminum were required to produce beverage containers in 1969. This amounted to 44.9, 2.0, and 5.6 percent, respectively of the total container glass, steel, and aluminum

Table 4. SUMMARY OF THE ESTIMATED MATERIALS USED TO PRODUCE BEVERAGE CONTAINERS, 1969

Type of material	Total U.S. production of material (thousand tons)	U.S. production of beverage containers (thousand tons)	Percent of U.S. production used for beverage containers
Glass	13,150	5,908	44.9
Steel	93,900	1,886	2.0
Aluminum	4,020	226	5.6

Source: Can Manufacturers Institute, Inc., Annual Report: Metal Can Shipments, 1969; Glass Containers Manufactures Institute, Inc., Glass Containers, 1970; Bureau of Mines, Minerals Yearbook, 1970.

produced that year. Some of the technological trends in beverage containerization which may affect the resource requirements are discussed in Appendix C.

2.2.5 Energy

In addition to the materials required to produce beverage containers, energy is required to transform these materials into the required shapes.

In a recent study the energy requirements of the current beverage container systems were estimated at 0.34 percent of the total U.S. energy demand.[10] The study also showed, however, that most of the energy consumed for manufacturing the containers, and packaging and distributing the beverages in the beer and soft drink industries is for manufacturing the container since the nonrefillable container requires several times as much energy to deliver a unit of the beverage to the consumer as does the system which uses a refillable container. The energy requirements of the beverage industry therefore could be substantially reduced, perhaps by 55 percent, if the industry converted entirely to refillable containers.[11] This would reduce the beverage container's share of total U.S. energy demand to about 0.19 percent.

An attempt to conserve resources by reducing beverage container production would not be complete nor identify net impacts on resources. This is because it does not take into account the possibility that consumers may spend less for beverages if they were all packaged in refillable bottles or if their prices were lower than for nonrefillable bottles and cans, and the likelihood that the consumer would then purchase other products whose energy requirements are unknown. A more complete approach to energy conservation would be to consider the energy requirements of all products. Under such an approach the beverage container may not get a high priority.

Although we have not made any intensive comparison of the resource requirements of other consumer products vis-a-vis those of beverages, some insight can be obtained using input-output analysis. This analytical technique provides a method of determining the interdependence among the industries or sectors of an economy. Based on the latest national input-output table, which was developed using the interrelationships existing in 1963, we have tabulated the resource requirements of the 83 major consumer expenditure categories used by the U.S. Department of Commerce. These relationships are expressed in dollars of resource (e.g., coal) per dollar of demand for the consumer expenditure (e.g., food). The complete tabulation is shown in Appendix D. In Table 5 we have extracted the resource requirements for Food Purchased for Off-Premise Consumption (the major food category) and for Bottled and Canned Soft Drinks, the only beverage for which adequate detail is available in the input-output table.*

Soft drink purchases represent about 3.2 percent of consumer expenditures for Food Purchased for Off-Premise Consumption (beer is 3.6 percent)[12] and appear to have only a slightly different resource requirement than those for the larger food category of which they are a part. However, this was in 1963 when about 98 percent of soft drink fillings were in refillable bottles rather than 62 percent in 1969. Therefore, the resource requirements for soft drinks may have increased somewhat since 1963. All consumer expenditures, however, require natural resource and energy inputs. Many require more than beverages both in proportion of their total input and in absolute amounts.

A policy based on energy conservation alone would ignore the value

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*Beer is included with all alcoholic beverages.

Table 5. NATURAL RESOURCE REQUIREMENTS FOR CONSUMER EXPENDITURES FOR FOODS AND SOFT DRINKS

Industry	Food purchased for off-premise consumption* (dollars)	Bottled and canned soft drinks* (dollars)
Iron and ferroalloy ores mining	0.00097	0.00212
Nonferrous metal ores mining	0.00059	0.00091
Coal mining	0.00230	0.00273
Crude petroleum and natural gas	0.01295	0.01095
Stone & clay mining and quarrying	0.00163	0.00256
Chemical & fertilizer mineral mining	0.00107	0.00121
Electric, gas, water, and sanitary services	0.02580	0.02632

Source: Survey of Current Business, Vol. 49, No. 11 (November 1969) and Vol. 51, No. 1 (January 1971); Input-Output Structure of the U.S. Economy, 1963, Vol. 3., U.S. Department of Commerce.

*Each entry represents the dollar output required, directly and indirectly, from the industry named at the beginning of the row, for each dollar of consumer purchases of the group of products or product named at the head of the column.

a beverage purchaser may place on convenience. Purchasing habits indicate that convenience is currently quite important to consumers as indicated by the average price premiums of about 1 and 2 cents, respectively, for beer and soft drinks in nonrefillable bottles. In 1969, consumers spent about $598 million for the convenience of not having to return empty bottles. The amount may be significantly higher if forfeited deposits are included. If one assumes that the market mechanism works reasonably well, that there is effective competition, then it may be possible to state with considerable assurance that consumers are getting what they want. However, this argument assumes that the consumer has a choice of beverage containers. This assumption is not completely warranted since 80 percent of beer fillings and all the house brand* soft drinks marketed by supermarket chains are sold only in nonrefillable containers. However, the consumer still has the choice of containers for many brand name soft drinks, but trends show he is losing it. He once had the choice for beer and lost it.

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*House brand soft drinks are those sold under the retailer's name.

It does not appear reasonable to describe the beverage container problem as a problem of natural resource or energy utilization. It is a small user of these resources both absolutely and when compared to other consumer items. This is not meant to imply, however, that natural resources and energy are not being consumed too rapidly. They may be; however, a more complete approach would be to examine the present and future demand and supply conditions for our resources and then establish a policy regarding their overall rate of use rather than controlling one product class.

2.3 Solid Waste

The collection and disposal of the millions of tons of solid waste generated each year has created serious problems for municipal governments in finding adequate disposal sites and meeting the rising costs of solid waste management. Beverage containers, as a share of solid waste, contribute to the growing volume, the associated problems of costs, and the scarcity of suitable disposal sites. The quantity of beverage containers going into solid waste disposal is not precisely determinable, either by volume or weight. Estimates have been made, however, on the basis of limited sample data and the known rate of container production.

2.3.1 The Volume, Composition, and Cost of Solid Waste

In 1968, the year for which the most complete survey data is available, an estimated 7.5 billion tons of all types of solid waste were generated from all sources. This includes approximately 2 billion tons of rock and overburden generated by strip mining; 2 billion tons of sediment washed annually into streams as a result of agriculture;[13] 2 billion tons of agricultural waste; 1.1 billion additional tons of mineral waste;[14] and 360 million tons of residential, commercial, and industrial waste.[15]

The residential, commercial, and industrial wastes have received the most attention since they are typically generated in highly populated areas where collection and disposal cause serious problems for municipal governments. About 170 million tons of these wastes were self-collected and disposed of, leaving about 190 million tons that were collected and disposed of by public and private collection agencies, or an average of about 5.32 pounds per person per day.

Table 6 shows the national distribution of the 5.32 pounds by source for rural and urban areas. Differences in income and styles of living between the urban and rural population presumably account for the differences in the amounts of collected household solid wastes. Household sources account for about 57 percent of the total; commercial sources, 19 percent; and industrial sources, 11 percent. The remaining 13 percent are from demolition, construction, street and alley refuse, and miscellaneous sources.

The first three categories in Table 6 may be combined as residential and commercial solid waste. This portion of collected solid waste is a better basis for evaluating the impact of beverage containers than total solid waste, since the collected beverage containers are probably in this portion, and it is the one that is of most concern to municipalities and the public.

Residential and commercial solid waste amounted to 4.15 pounds per capita per day in 1968 or approximately 78 percent of total collected solid waste. If the per capita figure is increasing at 4 percent annually and the population in 1969 was 200 million, then the total residential and commercial solid waste was 4.32 pounds daily per capita or 157.7 million tons. A continued rate of growth of 4 percent to 1976 would result in 5.68 pounds daily per capita or 228 million tons yearly with a population of 220 million.

Separate estimates of collection costs are not available for the residential and commercial portions of solid waste. However, if we assume that cost is proportional to the manpower inputs, and that 70 percent of total solid waste manpower was employed for commercial and residential solid waste, the estimated cost of collection and

Table 6. AVERAGE DAILY SOLID WASTE COLLECTION, 1968

Sources of solid waste	Collections in pounds per capita		
	Urban	Rural	National average
Household	1.26	0.72	1.14
Commercial	0.46	0.11	0.38
Combined (residential & commercial)	2.63	2.60	2.63
Industrial	0.65	0.37	0.59
Demolition, construction	0.23	0.02	0.18
Street and alley	0.11	0.03	0.09
Miscellaneous	0.38	0.08	0.31
Total	5.72	3.93	5.32

Source: R. J. Black et al, _1968 National Survey of Community Solid Waste Practices: An Interim Report_, Department of Health, Education, and Welfare, 1968, p. 13.

disposal of commercial and residential solid waste was $2.55 billion in 1969, or $16 per ton. The collection cost was an estimated 79 percent of the total or $13 per ton and the disposal cost was 21 percent or $3 per ton.*

The composition of municipal refuse varies from place to place depending upon regulations, the type of materials that are collectable, the season, the level and distribution of commercial and industrial activity, and the pattern of residential consumption. Although there have been several studies of refuse composition during the last few years, comparing the results is difficult due to the different classification schemes used and the varied reasons for the studies (to design incinerators, compost plants, sanitary landfills, or other methods of disposal). Nevertheless, several patterns of waste composition are discernable. In most studies, paper products are the largest component (about 50%), food is next (15-20%), metal is third (8-11%), and glass is fourth (6-9%). Table 7 provides the results of a typical study on solid waste composition.

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*The $2.55 billion is 70 percent of the $3.5 billion total cost of solid waste in 1968 extrapolated to 1969 at a 4 percent rate of growth.[16] The $3.5 billion does not include the per capita investment in refuse containers, garbage grinders, on-site and backyard incinerators, and the money invested by industry for transporting and disposing of their own materials.

2.3.2 The Beverage Container in Solid Waste

None of the studies of the composition of solid waste has specifically identified the beverage container share. However, we have estimated its share based on the weight of beverage containers produced.

In 1969 about 6.630 million tons of glass and metal containers were produced for beer and soft drinks (see Table 8). We estimate that 2.2 billion of the containers weighing an estimated 0.353 million tons were littered. An estimated 10 percent of the remainder were self-collected and self-transported (applying the national average for all residential and commercial solid waste). The remaining 5.649 million tons of discarded containers represent about 3.6 percent of the estimated 157.7 million tons of residential and commercial refuse in 1969.

Because solid waste collection and disposal cost data are so incomplete, there is no completely satisfactory method for estimating the cost burden placed on solid waste management by the discarded containers. However, some insights are possible by allocating solid

Table 7. COMPOSITION OF MUNICIPAL REFUSE, 1966-68

Type of Refuse	Percent by weight
Food waste	18.2
Garden waste	7.9
Paper products	43.9
Plastic, rubber, leather	3.0
Textiles	2.7
Wood	2.5
Metal	9.1
Glass and ceramic	9.0
Rock, dirt, ash, etc.	3.7
Total	100.0

Source: Harry J. Little, "Solid Waste Composition," Bureau of Solid Waste Management, 1968.

Table 8. ESTIMATED DISPOSTION OF METAL AND GLASS CONTAINERS IN SOLID WASTE, 1969

Type of beverage container	Weight of shipments* (million tons)	Estimated weight of littered containers† (million tons)	Estimated weight of containers in solid waste (million tons) self-collected‡	Estimated weight of containers in solid waste (million tons) services collected§
Cans				
Beer	1.214	0.096	0.112	1.006
Soft drink	0.898	0.038	0.086	0.774
Bottles				
Refillables				
Beer	0.139	0.015	0.012	0.112
Soft drink	0.794	0.113	0.068	0.613
Nonrefillables				
Beer	1.627	0.076	0.156	1.395
Soft drink	1.958	0.015	0.194	1.749
Total	6.630	0.353	0.628	5.649

*Can Manufacturers Institute, Inc., Annual Report: Metal Cans Shipments, 1969, Washington, D.C., 1970; and Glass Containers Manufacturers Institute, Glass Containers, 1970 Edition.

†Research Triangle Institute.

‡Based on the assumption that 10 percent of the nonlittered containers are self-collected and self-transported.

§Collected and transported to disposal sites by public or private sanitation services.

waste costs to beverage containers based on their share, by weight, in solid waste.

We stated our estimate above that 5.649 million tons of beverage containers were collected by public and private sanitation services. At the average of $13 per ton these services would be valued at $73.4 million. The littered and the self-collected and transported beverage containers required disposal, but the method and site are unknown. We have assumed that all littered, self-collected, and services-collected beverage containers were ultimately disposed of in legal solid waste disposal sites, requiring an expenditure of $3 per ton, or $19.9 million, for their disposal. The total cost of beverage container collection and disposal on a share-of-weight basis is $93.3 million or 3.7 percent of the total cost of collected residential and commercial solid waste.

The elimination of beverage containers from solid waste, however, would not reduce the cost of solid waste by the full amount of $93.3 million, because collection costs are not linear with respect to the quantity of solid waste. That is, small changes in volume do not result in proportional changes in the cost of collection. Collection costs are more sensitive to the number of pickups and the distance between pickups, than to the weight of solid waste at each pickup. Disposal costs on the other hand, are sensitive to the volume of solid waste, and a linear relationship is probably a reasonable approximation. Thus the elimination of all beverage containers from solid waste would result in savings in disposal costs of about $19.9 million while the savings in collection costs are indeterminate, but certainly less than $73.4 million.

The beverage container share of collected residential and commercial solid waste is increasing. In 1976 the weight of discarded beverage containers is projected to be 11.255 million tons, assuming the same average weight per container type in 1976 as in 1969 (see Table 9). If 5 percent of the containers are littered and 10 percent of the remainder are self-collected, then 9.697 million tons will be collected as solid waste. Since residential and commercial solid waste is expected to reach 228 million tons by 1976, the share of beverage containers will then be 4.2 percent of collected residential and commercial solid waste compared with 3.6 percent in 1969. The littered and self-collected beverage containers (1.558 million tons) would also show up in solid waste for disposal. If the costs per ton of collecting and disposing of solid waste in 1976 remain the same, the collection cost implied for beverage containers would be $126.1 million and the disposal cost would be $33.8 million for a total of $159.9 million.

Table 9. PROJECTED DISPOSITION OF METAL AND GLASS CONTAINERS IN SOLID WASTE, 1976

Type of beverage container	Projected weight of shipments* (million tons)	Estimated weight of littered containers† (million tons)	Estimated weight of containers in solid waste (million tons)	
			self-collected‡	services collected§
Cans				
Beer	1.805	0.142	0.166	1.497
Soft drink	2.011	0.084	0.193	1.734
Bottles				
Refillables				
Beer	0.105	0.010	0.010	0.085
Soft drink	0.589	0.066	0.052	0.471
Nonrefillables				
Beer	2.777	0.130	0.265	2.382
Soft drink	3.968	0.048	0.392	3.528
Total	11.255	0.480	1.078	9.697

*Research Triangle Institute

†Based on the assumption that 10 percent of the nonlittered containers are self-collected and self-transported.

‡Collected and transported to disposal sites by public or private sanitation services.

This total would be 4.3 percent of the total cost of $3.69 billion for residential and commercial solid waste costs projected for 1976 compared to 3.6 percent estimated for 1969. While the cost per ton of collecting and disposing of solid waste will probably increase from 1969 to 1976, this increase will not affect the beverage container share but will increase the absolute cost.

Three strategies may be used to diminish the importance of beverage containers as a solid waste management problem. One is to reduce the quantity of discarded containers; many legislative proposals attempt to do this by requiring that beverage containers be returned. Another approach is to recycle empty containers. About 13 percent of the aluminum containers were recycled in 1971 (a bounty of about 0.5 cent per container was paid by the aluminum producers).[17] Finally, better disposal methods are possible. In open dumps, the beverage containers in their original shapes may hold moisture and breed mosquitoes and other insects. Neither material can be composted: glass can be ground and left in the compost, but steel containers must be removed magnetically or ballistically. In another process, pyrolysis, the glass and metal must be removed prior to processing, and disposed of separately.[18]

2.3.3 Conclusion

Beer and soft drink containers are a small but growing percentage of residential and commercial solid waste. However, they do contribute to the mounting need for land area for disposal and to the increasing costs of solid waste collection and disposal.

It is obvious that the impact of removing all beverage containers from solid waste would be small. The largest impacts would be on the need for land area for disposal and on disposal costs. There would not be a linear relationship between collection services and costs and a reduction in the number of beverage containers alone. However, if lesser amounts of other products were discarded along with fewer containers so that collection frequencies could be reduced, additional savings might be possible.

In order to have a significant impact on solid waste management, a beverage container policy would have to be part of a broader program for stimulating recycling or encouraging source reduction of many other waste products.

2.4 Litter

The increased volume of litter along highways and in vacant lots, waterways, recreation areas, and even in remote forest areas, has become a national esthetic problem, and is contributing to the mounting cost of solid waste collection. Public concern is indicated in the results of a recent survey in which 86 percent of the respondents said they considered littering to be a serious problem.[19]

The beverage container, being both highly visible and representing a significant share of littered items, has contributed to both the esthetic problem and collection cost increases.

2.4.1 The Volume and Composition of Litter

Although there have been a number of State and local surveys of litter, there has been only one national survey.[20] This was a 29-State roadside survey of littered items accumulated on primary highways* during a 30-day period in the fall and winter of 1968 or spring of 1969. The Research Triangle Institute designed the study, selected the sample, processed the data, and wrote the report. Each of the participating States provided the manpower to make the collections. There were 290 road sections, each two-tenths of a mile long, selected at random. Two pickups were made, the first to remove any accumulated litter and 30 days later the second in order to determine the monthly littering rates.

The study has several drawbacks which should be noted. First, it is not comprehensive; it covered only interstate and primary highways. Secondary State highways and county and local roads were not included. It was only a roadside survey and did not include forests, parks, beaches, or other recreational areas, nor were city streets included in the sample. Also, the survey was made in the fall and winter rather in the summer when littering is greater. Finally, the study was based on unit counts of littered items. This measure does not provide any explicit indication of the visibility of the items. In spite of these limitations, the study can provide valuable insight regarding the volume and composition of litter.

The study found that the average monthly accumulation of litter along primary roads was about 1 cubic yard per mile; the accumulation varying with the volume of traffic. The cubic yard contained an average of 1,300 items (See Table 10); items not normally collected (e.g., small scraps of paper, pop tops, broken glass, etc.) are not included in the 1,300 but these do add to the esthetic and safety problems.

Using correlations between average daily traffic (ADT) and litter from the study, we have developed estimates of the total number of items

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*Primary highways account for about 12 percent of all rural and municipal highway mileage [21] and about 48 percent of all vehicle miles.[22]

Table 10. DISTRIBUTION AND ESTIMATED NUMBER OF ITEMS OF ROADSIDE LITTER ANNUALLY, 1969

Type of litter	Items per mile per month-- primary roads	Distribution of littered items (percent)	Estimated Number of items littered all roads (millions)
Paper	776	59.3	7,127
Cans	213	16.3	1,809
Plastics	75	5.7	650
Bottles	77	5.9	702
Miscellaneous and special interest	167	12.8	1,707
Total	1,308	100.0	11,995

Source: Research Triangle Institute, National Study of the Composition of Roadside Litter, 1969.

littered annually along our nation's highways. These estimates imply that ADT is the best single explanatory variable. While this may be so for highway litter, population may be a more important variable in urban areas. However, good data on urban littering are not available. Therefore, the estimates will have to be interpreted carefully.

From the litter-ADT correlations, and based on 1016 billion vehicle miles in 1968,[23] we estimate that about 12 billion items, of a size and nature normally collected by State highway crews, were littered in 1968. Because the litter survey covered portions of 1968 and 1969, and since the estimates of the total items littered are only broad indications, we have used these estimates as reflecting 1969 littering.

Most of the littered items are paper. Cans (mostly beverage containers) are the second largest component of the items littered. There is, however, a subtle but important difference between the items littered and the items collected. Table 11 illustrates this difference. In the first pickup, paper items were a smaller percent of the total, and cans and bottles a larger percent. Although the difference may in part be due to changes in the rate of littering of items between the two time periods, we believe the most important factor is that paper

Table 11. DISTRIBUTION OF ROADSIDE LITTER

Type of litter	First pickup (percent)	Second pickup (percent)
Paper	48.8	59.3
Cans	28.2	16.3
Plastics	4.7	5.7
Bottles	6.9	5.9
Miscellaneous and special interest	11.4	12.8
Total	100.0	100.0

Source: Research Triangle Institute, National Study of the Composition of Roadside Litter, 1969, Table A-01.

degrades or blows away with the passage of time, whereas, cans and bottles do not.*

The lack of good time-series data on littering precludes the identification of trends in littering with any certainty. Keep America Beautiful, Inc. (KAB) has, however, developed a national litter index from the available data, which is sometimes used to identify trends. The index is the ratio of vehicle miles to State litter collection costs with 1964 as the base year. It reflects the opportunity to litter (vehicle miles) versus behavior (costs), to the degree that litter costs reflect the volume of litter, and, therefore, behavior. As Table 12 shows, even though collection costs have been increasing, the index has declined for the past few years due to the more rapid increase in vehicle miles. KAB attributes the decline in the index to the success of public education programs, enforcement of antilittering laws, and the provision of facilities for disposing of travel trash.[24]

We do not believe, however, that such optimism is justified. The index is the ratio of vehicle miles to litter collection costs and, as

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*If left long enough, steel cans will, of course, rust. However, most would be collected before they deteriorated.

Table 12. THE KEEP AMERICA BEAUTIFUL NATIONAL LITTER INDEX AND THE COST OF LITTER COLLECTION ON STATE HIGHWAYS

Year	KAB index	State litter collection costs (million, $)
1964	100.00	$21.6
1965	101.91	23.1
1966	101.41	29.4
1967	101.45	30.9
1968	102.82	35.4
1969	98.26	37.1
1970	94.27	39.5

Source: Keep America Beautiful, Inc.

such, does not show the trend of the absolute quantities. Also, collection costs have been subject to inflation reducing the amount of real expenditures on litter collection significantly from the reported collection costs.

With consumption of packaging materials projected to increase at an annual rate of 3.6 percent to 1976,[25] and our projection that vehicle miles will increase at an annual rate of 4.6 percent to 1976, it seems probable that littering will grow by at least 4 percent annually to 1976.

Litter collection costs data are quite fragmentary. KAB has been tabulating State expenditures for litter collection since 1963. In that year, the total reported State expenditures were $19.7 million. The amount has grown about 9 percent per year since then, reaching $37.1 million in 1969. These costs are only a small part of all expenditures, however, since they do not include the county, city, and Federal expenditures for roadside litter collection nor any expenditures for litter collection in recreational areas. A recent study[26] provides more complete estimates of total current public litter collection costs of either $164 or $214 million annually depending on whether the public costs of cleaning vacant lots are included.* If the private costs of litter collection are included (vacant lot cleanup, voluntary cleanup campaigns, antilitter advertising, and other donations of time and materials), the total is about $444 million.* However, since the use of such voluntary labor does not involve the diversion of productive labor from alternative uses and since society has not chosen to allocate more resources to litter collection, it is our opinion that the costs to society of litter collection are reflected only in the public costs which are borne by all members of society.

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*These costs still do not include the public costs of collecting litter from Federal, State, and municipal parks or waterways.

2.4.2 The Beverage Container Share of Litter

On a unit basis, as shown in Table 13, beverage containers accounted for about 20 percent of the items littered over the one-month observation of the RTI highway litter study and about 30 percent of the items collected from the first pickup. These are, however, national averages and as such mask the differences which exist from area to area across the nation due to the variety of beverage consumption, attitudes, and mobility patterns.

The unit basis of measuring litter may cause a serious underestimation of the visibility of some littered items. For a recent study in Oregon, the volume of littered items was used rather than their number in an effort to provide a better indication of visibility. On that basis, cans and bottles contribute 62 percent of the total volume of litter from along Oregon highways,[27] which is significantly more than the container's unit share expected if Oregon's litter were typical of the national average litter composition. The use of volume as the means of indicating the visibility of littered items, however, implies that one large item, e.g., a tire casing, would be equal to a number of smaller items, e.g., beverage containers, even though the casing is seen once and the containers are spread out over some distance.

What is needed is a better method of measuring the visibility of

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*Litter collection at fast-food outlets and shopping centers costs the owners and tenants of these facilities an estimated $100 million annually. These costs, however, are privately financed.

Table 13. DISTRIBUTION OF THE BEVERAGE CONTAINER ELEMENT OF ROADSIDE LITTER (PERCENT OF TOTAL ITEMS FOUND IN LITTER)

Type of beverage container	First pickup	Second pickup
Cans		
Beer	21.7	11.8
Soft drink	4.4	3.1
Bottles		
Refillable		
Beer	0.4	0.4
Soft drink	1.6	1.6
Nonrefillable		
Beer	2.7	2.3
Soft drink	0.8	0.5
Total	31.6	19.7

Source: Research Triangle Institute, National Study of the Composition of Roadside Litter, 1969, Table A-01.

littered items than is provided by either unit counts or volume estimates in order to better identify the beverage container share in the litter problem. Such a measure might be based on the surface area and reflectability of the littered items. Another possibly is to survey consumers to determine their perceptions regarding the littered items as was done in a recent survey of consumers in 4 major cities. Those surveyed responded that they thought beverage containers were at least 40 percent of litter.[28] This may be a better indication of public concern over littered beverage containers than would be indicated based on their unit share.

Since we do not have a thorough, national study that provides any better indication of visibility than the unit counts provided by the RTI litter study, we have continued to use it here to develop the analysis of littered containers. However, as stated above, the tendency of the data to understate the beverage container share of the litter problem should not be overlooked.

We conservatively estimate that at least 2.2 billion containers, or 5 percent of all containers discarded, were littered in 1969 (see Table 14) based on ADT-littered-container relationships.

As shown in Table 14, cans account for 75 percent of the littered containers; beer cans alone account for over 60 percent of all littered containers. The major consumers of beer are between the ages 21 and 34, are motor vehicle operators, and perhaps, may be more likely to litter if they become inebriated. Soft drink consumers, on the other hand, are typically between the ages of 10 and 29; many are not motor vehicle operators and might be restrained by their parents from littering from the family automobile. Nonrefillable beer bottles and refillable soft drink bottles accounted for most of the littered bottles in 1969.

While these figures regarding the number and types of containers littered are both necessary and useful, additional insights are provided by comparing the number of littered containers to the number of fillings. Table 15 provides those percentages.

Table 14. DISTRIBUTION AND ESTIMATED NUMBER OF LITTERED BEVERAGE CONTAINERS, 1969

Type of beverage container	Items per mile per month--primary roads	Distribution of littered containers (percent)	Estimated number of littered containers (million)
Cans	193	75.4	1,637
Beer	153	59.8	1,218
Soft drink	40	15.6	419
Bottles	63	24.6	596
Refillable	26	10.2	256
Beer	5	2.0	45
Soft drink	21	8.2	211
Nonrefillable	37	14.4	340
Beer	30	11.7	283
Soft drink	7	2.7	57
Total, all types	256	100.0	2,233

Source: Based on data presented in: Research Triangle Institute, National Study of the Composition of Roadside Litter, 1969.

From Table 15 we can see that beer cans are littered about twice the rate of soft drink cans, and nonrefillable beer bottles about four times the rate of nonrefillable soft drink bottles. However, soft drinks in refillable bottles are littered about twice the rate of beer in refillable bottles. We believe the reason for this paradox is that beer sold in refillable bottles is frequently less expensive than that sold in nonrefillable bottles, and beer in refillable bottles is sold mostly to taverns, bars, and restaurants. It would be quite unwarranted to assume, therefore, that the littering rate for beer containers could be reduced to 0.4 percent if all beer were packaged in refillable bottles with current deposit levels. However, a comparison of the soft drink littering rates does indicate that the refillable bottle is littered at a rate somewhat below that for the nonrefillable bottle and significantly below the rate for soft drinks in cans.

Because of the lack of data on the littering of beverage containers over several time periods, there is no completely satisfactory method of identifying the trends in the littering of beverage containers.

Table 15. ANNUAL RATE OF LITTERING OF BEVERAGE CONTAINERS, 1969

Type of beverage container	Proportion of fillings littered (percent)
Cans	6.5
Beer	7.9
Soft drink	4.2
Bottles	1.4
Refillable	0.7
Beer	0.4
Soft drink	0.8
Nonrefillable	3.8
Beer	4.7
Soft drink	1.2
Total, all types	3.0*

Source: Research Triangle Institute.

*Estimated number of littered containers divided by total fillings.

However, some insights on possible future trends can be obtained by applying the littering rates for 1969 presented in Table 15 to our containerization projections of 1976. Table 16 provides the results of these calculations. The result of this exercise indicates that with the growth in beverage consumption projected and the continued shifts expected in beverage containerization to the nonrefillable container, it will take a substantial change in consumer behavior (which is reflected by the proportion of fillings littered) to keep the number of littered containers from increasing less than 8 percent annually. Without such a change in behavior, beverage containers will comprise about 25 percent of all littered items in 1976 compared to 20 percent in 1969 assuming the number of all littered items increases 4 percent annually.

If we assume that the cost of litter collection is proportional to the unit share of littered containers and use the estimate of $214

Table 16. PROJECTION OF LITTERED BEVERAGE CONTAINERS, 1976

Type of beverage container	Proportion of fillings littered, 1969 (percent)	Projected fillings, 1976 (millions)	Projected littered containers, 1976 (millions)	Annual growth rate in number of littered containers, 1969-1976 (percent)
Cans	--	--	3,064	9.4
Beer	7.9	28,843	1,959	7.0
Soft drink	4.2	26,328	1,105	14.9
Bottles	--	--	954	7.0
Refillable	--	--	168	-6.2
Beer	0.4	8,528	34	-4.1
Soft drink	0.8	16,805	134	-6.7
Nonrefillable	--	--	786	12.7
Beer	4.7	11,744	550	10.0
Soft drink	1.2	12,884	155	15.4
Total, all types	--	--	3,937	8.4

Source: Research Triangle Institute.

million for street, highway, and vacant lot litter collection by public agencies, then the beverage container's share (20 percent of litter) is a minimum of $43 million annually or about 1.9 cents per littered container. However, if both the public and private costs are included, the costs rise to about 3.9 cents per container. If, as we believe, the beverage container's importance in litter is significantly greater than is implied by its unit share of 20 percent because of its visibility and lack of degradability, it may even be appropriate to allocate a substantially greater portion of the total litter collection costs to beverage containers. For example, if beverage containers account for 40 percent of the litter problem, their dollar share would be $86 million for 1969.

If all litter collection costs continue to increase at the annual average of 9 percent recorded for State highway litter collection costs over the last six years, by 1976 they will have risen to $392 million. The beverage container share (25 percent) would then be $98 million.

2.4.3 Conclusion

The littered beer and soft drink containers are a substantial portion of litter. On a national basis this portion is probably at least 20 percent of the items littered and 30 percent of the items collected--the difference being due to the containers' lack of degradability. Because of the growth expected in beverage consumption and the continued trend to the more litter-prone nonrefillable container, it appears that without government intervention, both the number of containers littered and their share of total litter will be substantially greater in the future.

The inconsiderate acts of some beverage consumers probably costs the American public at least $43 million annually. The costs would undoubtedly be significantly greater if the esthetic costs of a littered environment could be estimated. Perhaps, for a time, most citizens were willing to tolerate a littered environment. However, with the larger number of containers being littered annually plus the mobility of the population, littered containers are seen more often by more people than ever before.

In our judgment, beverage containers are an environmental problem primarily because some consumers of beverages create social costs by littering their empty containers rather than disposing of them properly. These social costs are probably substantial because of the large number of beverage containers littered annually and because of the littered containers' high visibility. To a lesser extent, beverage containers are also a problem because they are a growing portion of the increasing amounts of solid waste that must be suitably collected and disposed of each year.

The remainder of this report is addressed to the alternatives available to government to reduce citizens' encounters with littered beverage containers and the beverage container element of solid waste, the methodology for choosing among the alternatives, the analysis of the alternatives, and our recommendations for a governmental policy.

Chapter 3: METHODS OF EVALUATING ALTERNATIVE GOVERNMENTAL POLICIES

3.1 Introduction

The policy alternatives available to the Federal Government for reducing the social costs of beverage containers can be broadly classified by types of approach, i.e., legal or administrative restrictions, financial incentives, and indirect influences. Classification in this way provides a basis for evaluation of characteristics common to each approach.

This chapter provides a discussion of the three approaches, followed by a discussion of the analytical methodology employed in this study for evaluation of specific policy alternatives within each approach.

3.2 Restrictions

Restrictions may prohibit the use of nonreturnable containers or those made of specified materials. Restrictions, therefore, rely primarily on legal restraint and enforcement.

Of the proposed legislation affecting beverage containers, almost half could be classified as restrictions although many also have incentive-type mechanisms attached to them. There are 156 that prohibit all types of nonreturnable containers and 28 that prohibit either glass or metal nonreturnable containers; others prohibit aluminum, polyvinyl chloride, and nondegradable containers, pull-tops, and containers sold from vending machines. The restrictions often define nonreturnables as containers on which no reasonable deposit is required.

Restrictions are popular because many view them as being both efficient and equitable. They are seen as going directly to the heart of the problem. In this view, if pollution is disruptive to man's social and natural environment, then it should be prohibited. Restrictions are often viewed as easy to establish and as equitable because they treat all polluters equally.

3.3 Incentives

Incentives are economic mechanisms designed to encourage socially desirable action from producers and/or consumers. For examples:

Deposits may encourage consumers to return empty containers for refilling. Residuals charges or taxes may encourage consumers to purchase products with the lowest charges. Subsidies may encourage industry to recycle wastes.

A number of legislative bills, almost equal in number to those classified as restrictions, were classified as incentives because they are economically oriented. Ninety-six bills call for deposits ranging from 1 to 10 cents, with 5 and 10 cents the most popular amounts. Sixty-seven impose a tax on the container that varies from 0.25 to 10 cents with the most common amount of 1 cent per container.

3.4 Indirect Influence

There are many alternatives that use indirect influence. A small percentage of the bills are of this type. Some require voluntary behavior from consumers or producers. Others propose further research on some aspect of beverage containerization.

3.5 Methodology for Analyzing Specific Policy Alternatives

Within the three types of approaches available, there are specific policy alternatives that could be implemented. In order to make an informed decision regarding the appropriateness of any specific policy alternative, each must be carefully and systematically analyzed. Several general criteria have been suggested by EPA for use in such analyses.[29] The remainder of this chapter describes the methodology to be employed in evaluating each specific policy alternative in terms of these suggested criteria. Wherever possible, quantitative techniques have been used. In many cases, however, qualitative judgment is necessary. The seven criteria to be discussed are: (a) predictability, (b) benefits, (c) costs, (d) equity, (e) administration, (f) type of mechanism, and (g) type of approach.

3.5.1 Predictability

Athough this criterion could be broadly applied to the degree of certainty associated with the estimated impacts of a specific policy on the other criteria, a narrower definition of predictability is used here. An attempt is made to predict the probable response in three system parameters which, in turn, affect many of the other criteria. These parameters are beverage prices, consumption, and containerization. Three general levels of the degree of predictability of a policy may be identified. At the first level, it may not be possible to determine whether there will be any changes in price, consumption, or containerization. On the next level, it may only be possible to determine whether these parameters will increase or decrease. Finally, it may be possible to quantify the expected change in prices, consumption, or containerization.

The problems of predicting the probable response in these variables can be illustrated by observing that in 1967 there were: 188 breweries, 3403 bottlers, 300 metal can and 120 glass container manufacturers,[30] 129,000 grocery stores,[31] and 199 million consumers,[32] many of whom would be affected by a specific government policy on beverage containers. With so many decision points, predictability is limited.

3.5.1.1 Beverage Prices. The prices of beverages are important both as indications of consumer welfare and because prices influence consumption.

We have estimated the change in beverage prices resulting directly from the implications of each policy, using the average beverage prices shown in Table 17. Any policy that requires the return of nonrefillable

Table 17. AVERAGE BEVERAGE PRICES FOR SINGLE DRINK CONTAINERS BY CONTAINER TYPE (10-12 ounce units)

	Refillable bottles	Nonrefillable bottles	Cans
Beer*	20¢	21¢	22¢
Soft drink†	12¢	14¢	15¢

*Based on survey price data for premium and regular beer developed by Hugh Folk for the State of Illinois. Regional variations are unknown but are probably significant.

†Research Triangle Institute. Based on popular cola franchise brands sold by supermarkets at popular prices.

bottles or cans would increase prices an estimated 1 cent per drink to cover additional handling costs.[33]

3.5.1.2 Beverage Consumption. Any change in beer and soft drink consumption will influence many of the other criteria. The two factors most responsible for changes in beverage consumption are the price of the beverage and the price of convenience.

Quantitative estimates of the price/consumption relationships for beer and soft drinks indicate that consumption is relatively unresponsive to small changes in price. For either beverage, an increase in price of 10 percent would result in a decline in consumption of about 2 percent.*

The price of convenience, or the value to the consumer of the convenience of not purchasing his beverage in a refillable bottle and returning it, also affects consumption. As this price increases, some consumers who prefer the nonrefillable bottle or can are expected to reduce their consumption of beverages and/or shift to refillable bottles. Because of problems of multicollinearity between some of the variables which affect beverage consumption, quantitative estimates of the relationships between the price of convenience and the consumption of beer and soft drinks have not been possible within the scope of this study.

A recent industry-sponsored study provided some insight to the role attributed by the industry to convenience. The study concluded that beer and soft drink consumption would decrease 8 percent if these beverages were packaged only in refillable bottles. This estimate may, however, overstate the role of convenience, for since the authors did not identify the means by which such a change in containerization might take place--for example, what level of mandatory deposits was contemplated--the implicit assumption exists that the price for convenience was infinite. In fact, however, the opportunity to discard a container and thereby avoid the inconvenience of returning it necessarily exists at a cost. Apparently the authors assumed that the cost would be so high that virtually no consumers would pay it.

Lacking quantitative data, our judgment and information available on beverage distribution channels have been used to provide an estimate of the effect on beverage consumption when a policy increases the price of convenience.

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* See Appendix E.

3.5.1.3 Beverage Containerization. The changes in containerization are not subject to explicitly estimated quantitative relationships. The changes, however, are frequently implied by the specific policy being evaluated or else subject to qualitative analysis. Changes in the number and/or type of beverage container may affect the impact that a policy has in terms of several of the other criteria.

3.5.2 Benefits

The possible benefits of any policy on beverage containers are related to the rationale for a policy on beverage containers. We concluded in Chapter 2 that the beverage container is an environmental problem primarily due to its role in litter, and secondarily, due to its role in solid waste. A policy generates benefits, therefore, to the extent to which it is likely to reduce the probability of persons encountering a littered beverage container, to reduce the beverage container element of solid waste, and to reduce the associated solid waste management costs of beverage container disposal.

3.5.2.1 Encounter with a Littered Beverage Container. Given the mobility of the population, the probability of encountering a littered beverage container is primarily a function of the rate of littering and the frequency of litter collection. To reduce encounters with littered containers, a solution must either reduce the rate of littering and/or increase collection frequency.

While it is possible to estimate the current rate of littering of beverage containers, littering is a complex behavioral phenomenon. Given the limited amount of information available on littering, it is not possible to quantitatively link a policy with its impact on the littering of beverage containers. The information developed, however, is used to make informed judgments on gross changes in littering rates resulting from a policy.

The frequency of litter collection is dependent on the availability of resources (labor and equipment) and the willingness of governmental units to use these resources for litter collection. We have estimated the increase in collection frequency possible when a policy generates revenue as the ratio of that revenue to the litter collection costs of beverage containers without a policy ($43 million in 1969).

3.5.2.2 Beverage Container Element of Solid Waste. The beverage container element of solid waste is the number of discarded containers. This number is directly calculated from the consumption and containerization estimates after subtracting the littered containers.

3.5.2.3 Solid Waste Management Costs of Beverage Containers. The discarded beverage container affects solid waste management costs when littered and subsequently collected, or when discarded to controlled waste collection systems. Reduction in these costs may be considered a measure of dollar benefits.

In order to estimate the potential savings in solid waste management costs if fewer containers were littered or discarded to solid waste, we have used linear relationships between (a) the estimated number of containers littered and their collection costs, and (b) between the number of containers discarded to controlled collection systems and their collection and disposal costs.

It is not expected that any such savings would actually be passed on to taxpayers in the form of a lower tax rate. Such savings, however, would release additional funds for more frequent collections of the remaining litter. The assumption of a linear relationship between costs and the number of littered containers appears reasonable since the beverage container makes up such a large share of litter. Furthermore, there are no data which imply any relationship other than a proportional one. Linear relationships between disposal costs and the number of containers discarded are also probably a reasonable first approximation. A similar assumption regarding collection costs, however, probably overstates the savings possible since the beverage container is only a small share of collected solid waste. Collection routes and equipment tend to be fixed over the short run and would not respond to small changes in the quantity of wastes discharged. Since there are no data available on the marginal costs of solid waste collection, linear relationships were used. The estimated savings in collection cost, however, are more a measure of potential savings that would occur if source reduction were applied to several elements in the solid waste stream at the same time.

3.5.3 Costs

Costs are the monetary and nonmonetary losses of consumers, producers, distributors, and government as a result of a policy. These costs include: beverage prices, cost of convenience, employment, investment, tax revenues, and personal income. Many of the costs are of a transitory nature which will cause temporary hardships but are essentially a redistribution of resources and would not be a net loss to society. Such redistributions are common in a market economy due to the shifts in market demand.

3.5.3.1 Beverage Prices. Any increase in the prices of beverages, all other things being equal, will reduce the welfare of beverage consumers. Changes in beverage prices are taken from the predictability criterion.

3.5.3.2 Cost of Convenience. The cost of convenience is the extra amount a consumer pays not to return a beverage container for refilling.

This pattern of convenience is common to all aspects of modern American life. The preference for convenience and willingness to pay for it cannot be ignored without stronger grounds than a difference in tastes or a feeling that nonrefillable containers are "wasteful". There is an ever-increasing pressure of time, money, distance, and activities that may reduce the enjoyment derived from life. Convenience of all types, including nonrefillable beverage containers may be one answer to the growing complexity of life.

The cost of convenience of an alternative policy is calculated by multiplying the number of units of beer or soft drinks sold in nonrefillable bottles or cans in 1969, or projected for 1976, times the net change in the price of the lowest priced container that will not be returned. In other words, this is the extra amount all consumers who purchased, or are projected to purchase, their beverage in nonrefillable bottles or cans would have to pay to maintain convenience. Economists will recognize that, lacking a demand function for convenience, we have estimated the loss in consumer surplus due to a higher price for convenience in a manner which is fairly accurate for small changes in price but may significantly exaggerate the loss when the price changes are large.

3.5.3.3 Employment. Many of the alternative policies have the effect of changing employment patterns. Both the direct and secondary employment impacts for the key industries affected have been estimated. While these estimates capture the main employment impacts, employment in other industries will also be affected due to the interrelationships in the economy. All employment losses are expected to be of a transitory nature, but they would create temporary hardship for some people. Because they are expected to be transitory, no effort has been made to calculate the indirect employment effects of the alternative policies. The employment changes are based on quantitatively estimated relationships between employment and output for the soft drink, malt liquor, wholesale beer distribution, glass container manufacturing, and metal can manufacturing industries. The additional employment required to handle returned containers in supermarkets was also estimated. The employment models are discussed in Appendix F.

3.5.3.4 Investment. When a policy significantly changes containerization or consumption, new investment may be required and/or existing investment may be made obsolete.

The investment costs of many of the alternative proposals are quite complex and could themselves be the subject of separate study. One of the major difficulties is the evaluation of the probable disposition of equipment which would be made obsolete by an alternative policy. The abandonment of thousands of machines across the country would certainly stimulate industry to look for other applications for them. For example, machines for rinsing containers are not presently economically convertible to washers. Can-filling machines are not presently economically convertible to bottle-filling machines. However, given an increase in the demand for bottle washers and filling machinery, coupled with a surplus of rinsers and can-filling machinery, such conversions may become economical. The extent to which such efforts were successful would significantly affect an alternative proposal's impacts on investment.

The detailed investment analysis made by the Midwest Research Institute[34] has been used as the basis for computing the change in investment required.

3.5.3.5 Tax Revenue. Policies which reduce beverage consumption will reduce tax revenues. There are three possible sources of losses in tax revenue: beer excise and beverage sales taxes, income taxes, and equipment writeoffs. None of these possible revenue losses, however, represent real losses to society since they are reallocations of resources, not reductions in resource utilization.

Beer excise taxes are currently $9.00 per barrel on the Federal level and an average of $4.50 per barrel on the State level. This $13.50 per barrel has been used as a basis for calculating the loss in tax revenue when beer consumption is reduced.

No changes have been calculated for sales tax revenues since a reduction in spending on beer or soft drinks would leave consumers with more money to spend on other items which would probably be subject to the sales tax.

No changes have been calculated for personal income tax losses since we expect displaced workers to be hired by other industries.

Tax losses that result from a writeoff of equipment will be of a temporary nature. The writeoffs estimated by the Midwest Research Institute have been used.

3.5.3.6 Personal Income. Personal income changes are directly associated with employment changes. Average wage rates have been used to calculate the initial income losses when workers are unemployed, and the income gains when new workers are added. The losses, however, are transitory to the extent that the unemployed find employment in other industries.

3.5.4 Equity

Equity is the equal treatment of equals and unequal treatment of unequals in proportion to their inequalities. For this criteria we have identified those beverage consumers by type of beverage and container who would bear the costs of a policy and those who would benefit.

3.5.5 Administration

Administration is the difficulty involved in implementing and enforcing a policy, and the political or geographic level on which it would have to be applied. We have used our judgment in analyzing a policy's administrative requirement.

3.5.6 Type of Mechanism

We have noted whether the policy is a restriction, uses an incentive, or relies on indirect influence.

3.5.7 Type of Approach

This criterion identifies whether the approach of the policy is specific to beverage containers and the beverage container problem or whether it could be applied to other environmental problems.

Chapter 4: ANALYSIS OF ALTERNATIVE GOVERNMENTAL POLICIES FOR RESOLVING THE BEVERAGE CONTAINER PROBLEM

4.1 Introduction

Many alternative proposals have been advocated by legislators, representatives of business and industry, and concerned citizens as being proper policy for governmental action on the beverage container problem. This chapter provides an analysis of the ten alternative proposals which have received the most attention and which cover the spectrum of alternatives available. The criteria set forth and discussed in Chapter 3 are used as the basis for this analysis.

When the impact of the alternative proposal in terms of a criterion can be quantitatively measured, estimates of that impact have been made for 1969, the last year for which complete data is available, and for 1976. In all cases, the impacts are calculated as if occurring instantaneously on a national level. In fact, however, many of the unfavorable impacts could be reduced by judicious planning and phasing. The next chapter provides an evaluation of these alternative proposals based on this analysis and offers recommendations for governmental policy on the beverage container problem.

4.2 Analysis of the Major Alternatives

Of the ten major alternative proposals, one is inaction--i.e., no new legislation--three are restrictions, three are incentives, and three are indirect influences. For many of the proposals, a complete analysis using all criteria is unwarranted because of uncertain effectiveness or because a proposal would have to be combined with another proposal in order to be effective. In these cases, a discussion of the major characteristics of the proposal has been provided.

4.2.1 Proposal 1: No New Legislation

No action on the beverage container problem is justified unless the general welfare of society is reduced or threatened. Inaction may still be preferable to action if a policy cannot be found which is equitable, administrable, and for which the net benefits exceed costs. Inaction may be justified if a problem has a low priority. Inaction is justified at any one level of government if the jurisdiction belongs to another level. Finally, legislative inaction is justified if the administrative procedures and financing are already established to handle the problem.

4.2.2 Proposal 2: Ban Nonrefillables (Restriction)

The most popular restriction is the proposal to ban nonrefillables. A telephone survey of Detroit housewives by the Midwest Research Institute found that 72 percent of the respondents there favor a ban.[35] However, a simple ban of nonrefillables may not cause any change in the current system of beverage containerization since some type of incentive will be required along with the ban to get consumers to return empty containers.

One possible alternative to government-established incentives is to rely on the public-concern of the large corporations that dominate beer and soft drink production to abide by the spirit of the law. They would probably require their franchised bottlers and distributors to impose deposits in order to insure the return of the nonrefillable containers.

Another incentive is to require deposits of a reasonable amount. In this case, the deposit is the effective mechanism and the means for achieving the ban. It is the deposit that is critical, because the success of the ban will depend on the level of the deposit. Mandatory deposits are discussed in Proposal 4 below.

4.2.3 Proposal 3: Ban Specific Materials (Restriction)

Six bills pending as of June 1971 would ban aluminum in beverage containers, four would ban polyvinyl chloride, and twelve would ban containers that are nondegradable, biodegradable, or combustible. These bills are apparently based on the belief that the material or class of materials is obnoxious to the environment. For example, the littered aluminum can remains intact and shiny and, therefore, highly visible until collected.

Banning aluminum cans would most likely cause a switch to steel cans. However, since they would usually be picked up before they began to rust, it is unlikely that there would be any significant improvement in the beverage container problem.

Polyvinyl chloride is not now being used nor is it expected to be used for beverage containers in the United States. Thus a ban on this material would have no impact on the current beverage container problem.

The proposed bans on nondegradable and noncombustible materials would be far-reaching since there is presently no degradable, combustible material that can replace glass or metal beverage containers. Such a degradable material may even be a polluter as it degrades. If a substitute material (e.g., plastic or water soluble glass) does become available, the conversion to the new container would cause dislocations in the industries concerned and might cause higher prices for beverages if the new containers were significantly more expensive. This type container may even cause an increase in littering if it is discarded more frequently because it is biodegradable.

4.2.4 Proposal 4: Require Specific Materials (Restriction)

The last major restriction is a requirement that only recyclable or reusable materials be used for beverage containers. Such a requirement would be impractical without some other mechanism: beverage containers must be returned if they are to be reused or recycled, and to insure returns, incentives must be used. Again, the incentive employed to encourage consumers to return the empty containers is the critical element of this restriction and must, therefore, be evaluated in its own right.

4.2.5 Proposal 5: Require Mandatory Deposits (Incentive)

Deposits have been the incentives traditionally used by brewers and bottlers to encourage the return of empty bottles for refilling. Many of the pending bills would require a mandatory deposit on all containers. When specified in pending bills, the deposit level is frequently higher than that prevailing today. Such mandatory deposits imposed by government would have the effect of placing an arbitrary value on all beverage containers and encourage consumers to return the empty containers and collect their deposit.

4.2.5.1 Predictability. The outcome that most people expect from a mandatory deposit would be a return to an all-refillables bottle system of beverage containerization. The reasoning behind this expectation is that if consumers are going to return empty containers, they would buy their beverages in the lowest priced package, which is usually the refillable bottle. Retailers and bottlers can be expected, the argument goes, to prefer the refillable bottle for two reasons: (a) it would be the lowest priced of the three container types, and (b) they would have to destroy cans and nonrefillable bottles, after refunding the deposit, to keep them from being returned again and again.

The certainty of the outcome in terms of container type depends primarily on whether and to what degree consumers return their empty beverage containers for the deposit. There is, however, no good information currently available regarding the relationship between the level of deposits and the percentage of the containers that would be returned. There is enough evidence to indicate that any relationships that do exist differ for each area of the nation depending on the local economic, demographic, and cultural characteristics. Low income consumers within urban areas apparently return refillable bottles at a lower frequency rate than high income groups, perhaps because they do not have adequate transportation, find the return more bothersome than do the others, or more frequently consume the beverage in some mobile situation. The northeast region consumes a smaller percentage of soft drinks in refillable containers than the rest of the country. This behavior may be due to higher incomes, a greater preference for convenience, or cultural differences that may place less weight on the informal contractural obligations implied by the refillable system. The results of a survey of the national pattern and attitudes toward refillable bottles is shown in Table 18 and Figure 6.

Several extravagant claims have been made about the lack of efficacy of higher deposits in raising trippage and improving the viability of the refillable system. An extrmeme example cited is the alleged experience of Pepsi-Cola in New York City, where the deposit was raised to 5 cents to protect a new inventory of 600,000 cases of 16-ounce refillable bottles. It is claimed that in 6 months the inventory was exhausted and customers had forfeited $720,000 in deposits. This

Table 18. REGIONAL CONTAINERIZATION PATTERNS

Region	Percent of volume		
	Refillable bottles	Unrefillable bottles	Cans
Northeast	47	33	20
South	70	15	15
Midwest	72	14	14
Southwest	60	20	20
Rocky Mountain	79	7	14
West	50	27	23

Source: Annual Softdrinks Sales Survey, 1970.

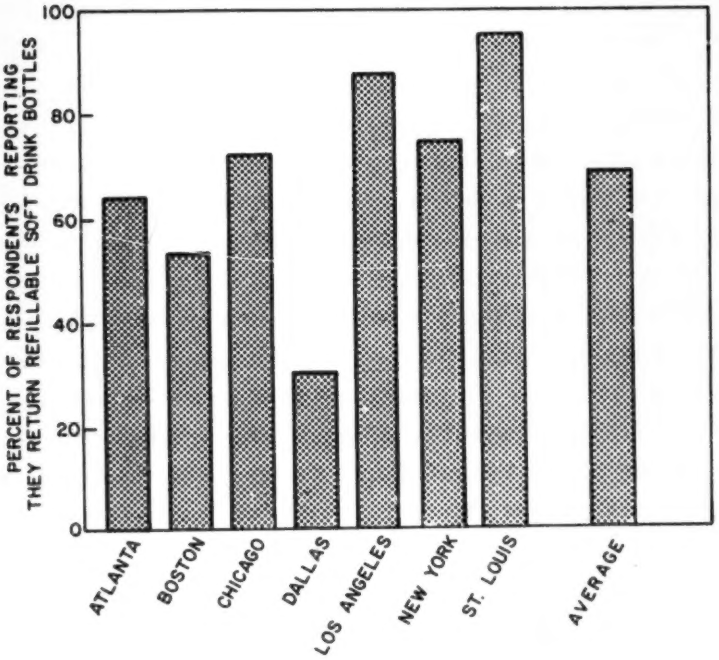

Figure 6. Consumer survey of returnable-bottle attitudes (from Softdrinks' Eighth Annual Report on Supermarket Shopping Habits, Softdrinks, July 1970).

example has been widely cited, yet there is no one in Pepsi's headquarters who will support this story. In fact, the increase in deposits caused many bottlers' inventories to increase and did maintain the viability of the system.

Because of lack of data on the level of deposits and the percentage of containers that would be returned, it is very difficult to predict on a national basis the probable outcome of mandatory deposits, except for two deposit levels--high and very low. With high deposits (probably 10 cents) the outcome should be a return to an all-refillables system. With a low deposit (perhaps 1 or 2 cents) there will probably be no significant change in containerization. Between these two levels, however, the outcome is very difficult to predict. The probable outcomes are analyzed below for the mandatory high deposit because it is the only one which will be effective.

(a) Beverage prices

In most areas of the nation, the refillable bottle is the least cost container for packaging beer and soft drinks. Table 19 shows the price changes for beer and soft drinks in refillable bottles that would exist with a mandatory 10-cent deposit. Although we expect a mandatory high deposit to cause a return to

Table 19. PRICE IMPACTS ESTIMATED WITH A MANDATORY HIGH DEPOSIT (10 CENTS) ON BEVERAGE CONTAINERS (per unit prices, single drink containers)

	Refillable bottles		
	Without Deposit	Deposit	Total with Deposit
Beer			
Actual	20¢	02¢	22¢
Expected outcome	20¢	10¢	30¢
Change	+00¢	+08¢	+08¢
Soft drinks			
Actual	12¢	02¢	14¢
Expected outcome	12¢	10¢	22¢
Change	+00¢	+08¢	+08¢

refillable bottles, there are uncertainties. For example, beer production is more centralized than soft drink bottling. Because of the longer transportation distances for beer, there are areas of the nation where beer in nonrefillable bottles or cans is less costly than in refillable bottles. For these areas, beer prices may increase as a result of an all-refillables system. Comparative, nationwide data does not exist, however, from which to identify these areas and their importance.

For the house brand* soft drinks, the price impacts are uncertain. Currently these drinks are packaged only in nonrefillable bottles and cans and sell at a significant price advantage over the franchise brands.† Whether the house brands would continue to be offered under a mandatory high deposit is unknown.

(b) Beverage consumption.

The impact of a mandatory deposit on beverage consumption is difficult to predict due to the lack of data on the importance of convenience to consumers. Bulk sales of beer and soft drinks (about 17 and 20 percent respectively of total sales) would not be affected. However, the increased cost of convenience would tend to reduce the demand for beverages by consumers who had been purchasing beer and soft drinks in nonrefillable containers. In 1969, these consumers purchased about 73 percent of all packaged beer and 42 percent of all packaged soft drinks. Our judgment is that purchases of 6 packs and similar large quantities of beverages for household consumption would not be greatly affected. There might be some initial resistance, but this should disappear as consumers become accustomed again to returning empties when they purchased beverages. With a high deposit it is conceivable though probably not very likely that there would be collections of bottles from the home by entrepreneurs who would pay an amount less than the deposit to collect the full deposit. Such entrepreneurs might even undertake household delivery of beverages since they would be going to the home to collect the empties anyway.

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*House brands are those sold under the retailer's name.

†Franchise brands are the major national brands.

Single-unit, single-drink sales of beverages, however, would be affected by a mandatory high deposit and the return to an all-refillables system. While single-unit, single-drink purchases of beer probably do not make up a large percentage of packaged sales, such sales are important for soft drinks. A survey of soft drink purchases in supermarkets revealed that in 1970, 26 percent of those interviewed had purchased 5 or fewer containers.[36] However, many shoppers had probably purchased quarts and not single-drink sizes so this figure may overstate the figures for single-unit, single-drink purchases. Vending machine (vended) sales would be more affected than regular retail sales. In 1969, about 20 percent of soft drink sales were vended.[37] About 29 percent of this amount is packaged in cups and would be unaffected by a mandatory deposit.[38] Therefore, 71 percent of vended sales or, alternatively, about 14 percent of all soft drink sales would be the most likely to experience significant sales decreases.

After examining the available data on containerization, distribution, and sales of beverages, it is estimated that the decrease in beer and soft drink consumption would be about 4 percent.* This is based on the assumption that one-half of the single-unit, single-drink purchases would not be made with a mandatory high deposit, and that one-half of the vended sales that are made in a mobile situation (traveling as compared to work or recreational settings) would no longer be made. Assuming no effect on the rates of growth projected for beverage consumption, these losses in consumption would be a temporary interruption in the sales growth of beer and soft drinks and would be made up in about one year.

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*This is at least double the consumption reduction implied by a Midwest Research Insitute (MRI) survey of consumers.[39] Consumers were asked how much their family's purchases of beer and soft drinks would be reduced if there were a law banning nonreturnable bottles and cans. The responses were grouped into broad percentage responses (0%, 1-10%, 11-25%, 26-50%, and 51-100%). Using the lower and upper bounds of each response class and multiplying by the percentage of consumers in each class, the weighted response is 1.1 to 2.8 percent reduction in both beer and soft drink purchases. This analysis assumes the percentage of consumers in each response class account for the same percentage of all purchases, and does not include those who didn't know what their consumption reduction would be.

In their study, however, MRI used an estimate of eight percent reduction in consumption with an all-refillables system. This estimate reflects the beverage industry consensus.

(c) Beverage containerization.

Legislation for mandatory deposits generally does not specify the nature of the container that must be used. Our conclusion is that the bottlers and breweries would find it worthwhile to use refillable containers if they are going to receive all or virtually all of the empties. At the present time the only refillable container is a relatively heavy glass bottle.* However, cans may become refillable or a glass bottle may be developed that is cheaper to recycle than to refill. Under present conditions, with the imposition of mandatory high deposits, beer and soft drinks would probably be packaged in refillable bottles, and the nonrefillable bottles and cans would be completely eliminated. A few cans might be produced for the luxury or convenience trade (e.g., camping) where lightness and compactness are desired.

The trippage cannot be predicted with a mandatory 10-cent deposit. Our assumption is that present levels of trippage would prevail. The rate might rise because of greater returns or scavenging. On the other hand, it could fall if consumers were willing to forfeit the deposit for convenience. This possibility does not seem very likely, however, because every container would be worth ten cents and even Americans do no seem so profligate as to throw away this amount.

Table 20 presents the containerization changes expected from a 10-cent deposit. Under 1969 containerization, more than 13

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*Some brewers on the West Coast are currently refilling nonrefillable bottles.

Table 20. CONSUMPTION AND CONTAINERIZATION IMPACTS ESTIMATED WITH A MANDATORY HIGH DEPOSIT (10 CENTS) ON BEVERAGE CONTAINERS (millions of fillings)

	Refillable bottles	Nonrefillable bottles	Cans	Total
1969				
Beer				
Actual	12,356	6,882	16,708	35,946
Expected outcome*	34,508	0	0	34,508
Change	+22,152	-6,882	-16,708	-1,438
Soft drinks				
Actual	28,722	6,363	11,764	46,849
Expected outcome*	44,975	0	0	44,975
Change	+16,253	-6,363	-11,764	-1,874
1976				
Beer				
Trend	8,582	11,744	24,843	45,169
Expected outcome*	43,362	0	0	43,362
Change	+34,780	-11,744	-24,843	-1,807
Soft drinks				
Trend	16,805	12,884	26,328	56,017
Expected outcome*	53,776	0	0	53,776
Change	+36,971	-12,884	-26,328	-2,241

Source: Research Triangle Institute.

*Consumption is assumed to decrease 4 percent due to the higher cost of convenience with a mandatory high deposit.

billion nonrefillable bottles and 28 billion cans would not have been produced if there had been a mandatory high deposit sufficient to cause a return to a refillables system. An additional 1.5 billion refillable beer bottles would be needed to handle the new fillings and nearly 1 billion more refillable soft drink bottles, assuming a trippage of 15.*

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*Current estimates of trippage are 14 for soft drinks and 20 for beer bottles.[40]

4.2.5.2 Benefits.

(a) Encounter with a littered beverage container.

The littering of beverage containers should virtually cease with a mandatory high deposit (10 cents). Most containers littered would probably be quickly scavenged.

(b) Beverage container element of solid waste.

All beverage containers are expected to disappear from solid waste with a mandatory high deposit.

(c) Solid waste management costs of beverage containers.

Since virtually no beverage containers are expected to be littered with a mandatory high deposit, there would be a potential savings of $43 million in litter collection costs (1969) assuming that beverage container collection costs are directly proportional to their unit share of all littered items.

Solid waste disposal costs are probably proportional to the volume of the solid waste although there are some fixed costs which would not be affected by a small reduction in the volume of solid waste. Collection costs are not linear to the volume (or weight) of solid waste, but since there are no data available on the marginal costs of collection, we have assumed a linear relationship for this analysis. For 1969, the cost of beverage containers in solid waste was estimated in Chapter 2 at $93.3 million. This amount would be the size of the benefits if all beverage containers were eliminated from solid waste.

4.2.5.3 Costs.

(a) Beverage prices

The average price paid by all consumers for beer and soft drinks should decrease because the higher priced nonrefillable bottles and cans are not expected to be available with a mandatory high deposit. This price reduction is not a benefit because the consumer is forced to purchase the beverage (if he still wants it) in a container and at a price that was previously available, but that many consumers did not choose.

Beverage prices were not projected to 1976 but kept at existing levels for the analysis. It is possible that prices, especially the differential prices between the various container types, will change by 1976 because of technology and labor wage rate changes. The refillable system uses large numbers of relatively low-paid employees. If the productivity of these workers lags behind that of the workers producing beverage containers, as is probable, the price advantage of refillables could be lost and refillables would then be phased out if there were no government policy that encouraged refillables. There is virtually no possibility that refillables would continue to be used if they did not offer a price advantage. If there is no price advantage and consumers are still forced to use refillable bottles as a result of a governmental policy, the price increase would then be a true social cost.

(b) Cost of convenience.

Many consumers are presently paying an average of 2 cents extra per filling for soft drinks and 1 cent extra for beer in order to have the convenience of a one-way, single-drink container that they do not have to return for a deposit. These convenience-oriented consumers would have to pay an additional 9 cents for beer and 8 cents for soft drinks, if they discarded the refillable bottle with a 10-cent deposit.* The cost of convenience is the most important social cost of an all-refillables system because it is a significant loss in welfare and not an income transfer or a reallocation in economic activity.

The extra expenditures for convenience by beverage consumers in 1969 was about $598.4 million. With a mandatory 10-cent deposit, the consumers that purchased beverages in nonrefillable bottles and cans in 1969 would have to pay an additional $3,573.3 million to

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*The reason they don't pay an additonal 10 cents rather than the 9 and 8 cents is because beer and soft drinks in refillable bottles are slightly cheaper (1 and 2 cents respectively) than when packaged in nonrefillable bottles.

Table 21. COST OF CONVENIENCE IMPACTS ESTIMATED WITH MANDATORY HIGH DEPOSIT (10 CENTS) ON BEVERAGE CONTAINERS

	Per filling	Total (millions)
1969		
Beer		
Actual*	1.0¢	$ 235.9
Expected outcome†	10.0¢	2,359.0
Change	9.0¢	2,123.1
Soft drinks		
Actual*	2.0¢	$ 362.5
Expected outcome†	10.0¢	1,812.7
Change	8.0¢	1,450.2
1976		
Beer		
Trend*	1.0¢	$ 365.9
Expected outcome†	10.0¢	3,658.7
Change	9.0¢	3,292.8
Soft drinks		
Trend*	2.0¢	$ 784.2
Expected outcome†	10.0¢	3,921.2
Change	8.0¢	3,137.0

Source: Research Triangle Institute.

*Current price differential between beverage in refillable and nonrefillable bottles.

†This is the amount all consumers who had purchased, or are projected to purchase, their beverage in nonrefillable bottles and cans without the mandatory 10-cent deposit would have to pay to maintain convenience.

maintain the convenience of not having to return the empty containers. See Table 21.

(c) Employment.

An all-refillables system of beverage containers would cause large additions to employment (60,800) in the beverage and distribution industries and large reductions (60,500) in the beverage container industries. The net effect is a small increase

Table 22. EMPLOYMENT IMPACTS ESTIMATED WITH A MANDATORY HIGH DEPOSIT (10 CENTS) ON BEVERAGE CONTAINERS

(thousands)

	1969			1976		
Industry	Actual	Expected outcome*	Change	Trend	Expected outcome*	Change
Soft drinks	128.6	141.2	+12.6	147.7	178.6	+30.9
Malt liquor	58.1	61.3	+ 3.2	62.0	69.3	+ 7.3
Wholesale beer	59.9	74.5	+14.6	70.9	93.0	+22.1
Retailing	19.6	50.0	+30.4	11.1	60.9	+49.8
Glass containers	71.5	55.8	-15.7	76.8	43.9	-32.9
Metal cans	68.1	38.6	-29.5	86.3	39.1	-47.2
Metals	617.7	602.4	-15.3	617.7	593.1	-24.6
Total	1,023.5	1,023.8		1,072.5	1,077.9	
Gain			+60.8			+110.1
Loss			-60.5			-104.7
Net			+ 0.3			+ 5.4

Source: Research Triangle Institute.

*Beer and soft drink consumption is assumed to decrease 4 percent due to the higher cost of convenience with a mandatory 10-cent deposit.

in employment. Table 22 lists the major gaining and losing industries. With total expenditures on beverages expected to be lower because of lower average prices, consumers will have extra income to purchase other products. Employment should then be created in other sectors of the economy as this income is spent.

These changes in employment do not by themselves represent a gain or loss to the economy. Some losses will result while those unemployed are looking for other jobs. Changes in demand and employment among industries occurs constantly in the U.S. economy. The switch to an all-refillables system would be a very drastic change centered in relatively few locations, so special steps might be taken to ease the impact.

(d) Investment.

A change to an all-refillables system brought about by a

Table 23. INVESTMENT IMPACTS ESTIMATED WITH A MANDATORY HIGH DEPOSIT (10 CENTS) ON BEVERAGE CONTAINERS (millions)

	Total writeoff	New investment*
Soft drinks	$ 181	$ 345
Malt liquor	169	501
Wholesale beer distribution	-0-	298
Retailing	-0-	24
Glass container†	161	-0-
Metal can	550	-0-
Metals	300	-0-
Total	$1,361	$1,168

Source: Jeff Maillie, The National Economic Impact of a Ban on Nonrefillable Beverage Containers. Midwest Research Institute, Kansas City, 1971, pp. 23,83,75,76, 78, and Research Triangle Institute.

*These figures are four percent lower than the amounts estimated if consumption had remained constant. MRI assumed an 8 percent decline in consumption.

†Trippage of 15; MRI assumed a trippage of 8.

mandatory high deposit of 10 cents would require additional equipment to fill and distribute refillable bottles. Much of the equipment used to manufacture and fill nonrefillable bottles and cans would become obsolete, useless, or superfluous. Table 23 contains estimates of both the writeoffs and new investment for 1969 with a 4 percent change in consumption. These changes in investment are based on estimates provided by Midwest Research Institute for the investment impacts of an all-refillables system with no change in consumption, adjusted downward by 4 percent by RTI to reflect the lower consumption expected with an all refillables system.

(e) Tax revenue.

The drop in beer consumption and a shift to a refillables-only system of beverage containerization expected from a mandatory high

Table 24. BEER EXCISE TAX IMPACTS ESTIMATED WITH A MANDATORY HIGH DEPOSIT (10 CENTS) ON BEVERAGE CONTAINERS

	Consumption (million barrels)	Tax* (millions)
1969		
Actual	114.9	$1,551.2
Expected outcome	111.1	1,499.9
Change	3.8	51.3
1976		
Trend	145.5	$1,964.3
Expected outcome	140.7	1,899.5
Change	4.8	64.8

Source: Research Triangle Institute.

*Based on Federal excise tax of $9.00 per barrel and an average State excise tax of $4.50 per barrel.

deposit will reduce beer excise tax revenues, and corporate tax revenues due to the investment writeoffs.

As shown in Table 24, with a consumption decrease of 4 percent 1969 beer excise tax revenues would be reduced by $51.3 million.

The total investment writeoffs, using the Midwest Research Institute's estimates would have been $1.4 billion. The metal cans and metals industries account for almost two-thirds of the total. If the writeoffs were spread over 5 years, the tax loss would be about $271 million annually for the period.

Since the writeoffs are made against pretax profits, the affected companies would keep a large share of their profits than otherwise, probably distributing some of it to their stockholders where it would be taxed. Therefore the $271 million probably somewhat overstates the tax loss.

(f) Personal income

The employment change will cause changes in the personal income generated by the beverage industries and their suppliers. Table 25

Table 25. PERSONAL INCOME IMPACTS ESTIMATED WITH A MANDATORY HIGH DEPOSIT (10 CENTS) ON BEVERAGE CONTAINERS (millions)

Industry	1969			1976		
	Actual	Expected outcome	Change	Trend	Expected outcome	Change
Soft drinks	$834.1	$915.8	+$81.7	$956.0	$1,158.4	+$202.4
Malt liquor	578.8	610.7	+ 31.9	617.6	690.4	+ 72.8
Wholesale beer	470.7	585.4	+114.7	557.1	730.8	+173.7
Retailing	113.8	290.1	+176.3	64.4	353.6	+289.2
Glass containers	189.4	75.5	-113.9	317.1	78.4	-238.7
Metal cans	260.0	0	-260.0	416.4	0	-416.4
Metals	144.7	0	-144.7	233.0	0	-233.0
Total	$2,591.5	$2,477.5		$3,161.6	$3,011.6	
Gain			+404.6			+738.1
Loss			-518.6			-888.1
Net			-114.0			-150.0

Source: Research Triangle Institute.

shows the earnings in the beverage industries and that part of the container, metal, and retailing industries that can be attributed to beverage containers. The total earnings under an all-refillables system are lower even though employment is higher. The reason is that the industries gaining employment generally have lower average earnings than those losing employment. Average earnings per employee under the present system were $7,688 in 1969 while an all-refillables system would have generated average earnings of $7,343.

The difference in total earnings is $114.0 million in 1969 and $150.0 million in 1976 if present earnings rates prevail. It is likely, however, that the differential between earnings in the various industries will narrow by 1976 and there may not be any reduction in earnings by that time.

4.2.5.4 Equity. A mandatory deposit on all beverage containers increases the cost of convenience to those beverage consumers who do not wish to return their empty containers whether or not they litter them. A mandatory high deposit (which is expected to result in an all-refillables system) also reduces the consumers' choice of container for beverages.

4.2.5.5 Administration. A mandatory high deposit creates various administrative problems, particularly if it is only established in a State or smaller area, rather than nationwide. A deposit system usually operates through a two-step process. The bottler, brewer, or distributor requires a deposit on each bottle from the retailer, who then requires a deposit from the consumer. The simplest technique for administering a mandatory deposit would be to require the distributor to demonstrate that he has received deposits from the retailer. The retailer in turn would then impose the deposit on the consumer so he would not lose his deposit. Spot checks could be made to insure that the deposit was being applied at the retail level.

The biggest problem is to insure that a deposit is refunded only if one has been made; that is, bottles from other areas with lower deposit levels should not be redeemed in an area with a high deposit. One way to prevent this possibility is to require a distinctive mark on the container. Another would be to require that the crown be returned and it could be marked distinctively. A convention that deposits would be applied only to the purchase of additional beverages would also reduce the incidence of interregional flows, although such an approach would impose another inconvenience on the consumer.

A possible problem with a high deposit that has been put forward is counterfeiting of bottles in order to collect the deposit. This is very unlikely. Glass container factories are large operations that require large amounts of capital and long lead times. Refillable soft drink bottles currently sell for about 10 cents, which also happens to be the most common high deposit proposed. Thus there would be little profit in counterfeiting.

Finally, the precautions mentioned in the preceding paragraph would tend to make counterfeiting risky and unattractive.

4.2.5.6 Type of Mechanism. The mandatory deposit proposal works through the market economy in achieving its objectives. Deposits are a currently accepted means of insuring that many rented items are returned. In almost all cases, however, the deposits are voluntarily established and set by the manager of the business to protect his investment. For example, deposits are commonly collected in renting real estate and other real property.

4.2.5.7 Type of Approach. A mandatory deposit is a fairly limited mechanism most applicable to products which can be reused. As such, it probably could not be effectively applied to other littered items or solid waste problems.

4.2.6 Proposal 6: Tax (Incentive)

A tax on beverage containers could impose on the beverage consumer the external costs incurred by society due to the littering of beverage containers. Such a tax would be on the container, the item littered, rather than on the filling, or the drink. Ideally the tax should be avoidable. If a consumer does not litter his empty container, the tax should be refunded. However, in practice, providing for refundability may be administratively difficult.

There are two general approaches to determining the proper level of a tax on beverage containers. The first would be to make the tax equal to the average per container social costs of all littered containers, by dividing the social costs by the number of containers produced. The second approach would be to set the tax at a level which would reflect the social costs of a littered container, by dividing the costs by the number of littered containers. Table 26 shows the difference in the tax rates under the two approaches for only the collection cost portion of the social costs of littered containers.

Nonrefundable taxes of 0.5 and 5.0 cents are analyzed below. These levels were selected in order to allow for the esthetic costs of a littered environment as well as the costs of collecting littered containers.

Table 26. LITTERED BEVERAGE CONTAINER COLLECTION COSTS ON A UNIT BASIS, 1969

Estimated number of littered containers (millions)	Estimated cost of collecting littered containers (millions)	Number of containers produced (millions)	Average collection cost per container (cents)	Collection cost per littered container (cents)
2,233	$43	43,835	0.1	1.9

Source: Research Triangle Institute.

4.2.6.1 Predictability. The low tax (0.5 cent) has greater predictability than the high tax (5.0 cents) because fewer changes in consumer behavior are expected.

(a) Beverage prices.

A nonrefundable tax will raise the price of beverages. The price increase for nonrefillable bottles and cans will be equal to the tax. The price increase for refillables will be substantially less because the tax can be amortized over several fillings. Table 27 shows the expected price changes. The price changes for beverages in nonrefillable containers are substantial enough to expect that they will be passed along to consumers. The prices of beverages in refillable bottles, especially under the low tax, however, may not result in immediate increases in beverage prices. As Table 27 shows, because the initial expected price changes would significantly widen the price differential between refillables and nonrefillables, deposits on refillables have been increased by 3 cents to keep consumers from treating them as convenience containers and discarding them.

The problem of predicting price changes is compounded somewhat by the possibility that some retailers may use the tax as an excuse to raise beverage prices still further. This can happen if beverage producers either formally or informally agrees to raise prices in concert. Competition and the possibility of antitrust action should, however, keep prices down to levels where costs are covered and a normal return on investment exists.

Table 27. PRICE IMPACTS ESTIMATED WITH A TAX ON BEVERAGE CONTAINERS (single drink sizes)

	Low tax (0.5 cent)				
	Refillable bottles				
	Beverage price	Plus deposit	Total cost	Nonrefillable bottles, total cost	Cans, total cost
Beer					
Actual	20.00¢	2.00¢	22.00¢	21.00¢	22.00¢
Expected outcome	20.03¢	2.00¢	22.03¢	21.50¢	22.50¢
Change	+ 0.03¢	0.00¢	+ 0.03¢	+ 0.50¢	+ 0.50¢
Soft drinks					
Actual	12.00¢	2.00¢	14.00¢	14.00¢	15.00¢
Expected outcome	12.03¢	2.00¢	14.03¢	14.50¢	15.50¢
Change	+ 0.03¢	0.00¢	+ 0.03¢	+ 0.50¢	+ 0.50¢

	High tax (5.0 cents)				
	Refillable bottles				
	Beverage price	plus deposit*	Total cost	Nonrefillable bottles,† total cost	Cans,† total cost
Beer					
Actual	20.00¢	2.00¢	22.00¢	21.00¢	22.00¢
Expected outcome	20.33¢	5.00¢	25.33¢	26.00¢	27.00¢
Change	+ 0.33¢	+3.00¢	+ 3.33¢	+ 5.00¢	+ 5.00¢
Soft drinks					
Actual	12.00¢	2.00¢	14.00¢	14.00¢	15.00¢
Expected outcome	12.33¢	5.00¢	17.33¢	19.00¢	20.00¢
Change	+ 0.33¢	+3.00¢	+ 3.33¢	+ 5.00¢	+ 5.00¢

Source: Research Triangle Institute.

*Deposits are expected to increase voluntarily; since, without such an increase, beverages in refillable bottles could be purchased and discarded at a price to the consumer which is less than that for the same beverage in nonrefillable bottles and cans.

†These prices are for illustration only since with a high tax, nonrefillable bottles and cans are not expected to continue to be used to package beer and soft drinks due to their significant cost disadvantage over refillable bottles.

(b) Beverage consumption.

The low tax of 0.5 cent is expected to decrease only slightly the consumption of beverages in nonrefillable containers (0.5 percent for beer and 0.7 percent for soft drinks) due to the higher prices. Since the changes in beverage consumption under a low tax are less than one percent, we have assumed that the system will not be responsive to such small changes. Therefore, the small changes in consumption expected under a low tax, have not been used to calculate changes in any of the other criteria, such as employment or income, which are affected by consumption.

A high tax, of 5.0 cents per container, would widen the price differential between refillable and nonrefillable bottles and cans and probably would be sufficient to encourage most consumers to purchase their beverages in refillable containers rather than pay the higher cost of convenience. In the analysis of high mandatory deposits given above, it was estimated that if the cost of convenience rose to such a level that virtually no consumers would pay for it, then consumption of packaged beer and soft drinks would decrease by 4 percent each. We continue to use that estimate here.

(c) Beverage containerization.

The small price increase, and hence consumption changes expected with a low tax, would not result in any significant changes in beverage containerization.

The high tax, however, is expected to cause a shift to a refillables-only system as discussed above. Table 28 shows the expected impacts.

4.2.6.2 Benefits. The benefits of a low tax are mainly in the form of revenue generation, whereas the benefits of a high tax are in revenue generation; reduced rates of littering of beverage containers, and reduced discard of containers to solid waste.

(a) Encounter with a littered beverage container.

The low tax will cause no change in the rate of littering; however, it would produce revenue. About $219 million would be

Table 28. CONSUMPTION AND CONTAINERIZATION IMPACTS ESTIMATED WITH A TAX ON BEVERAGE CONTAINERS (millions of fillings)

	Low tax (0.5 cent)				High tax (5.0 cents)			
	Refillable bottles	Nonrefillable bottles	Cans	Total	Refillable bottles	Nonrefillable bottles	Cans	Total
1969								
Beer								
Actual	12,356	6,882	16,708	35,946	12,356	6,882	16,708	35,946
Expected outcome*	No significant change		No significant change		34,508	0	0	34,508
Change					+22,152	-6,882	-16,708	- 1,438
Soft drinks								
Actual	28,722	6,363	11,764	46,849	28,722	6,363	11,764	46,849
Expected outcome*	No significant change		No significant change		44,975	0	0	44,975
Change					+16,253	-6,363	-11,764	- 1,874
1976								
Beer								
Trend	8,582	11,744	24,843	45,169	8,582	11,744	24,843	45,169
Expected outcome*	No significant change		No significant change		43,362	0	0	43,362
Change					+34,780	-11,744	-24,843	- 1,807
Soft drinks								
Trend	16,805	12,884	26,328	56,017	16,805	12,884	26,328	56,017
Expected outcome*	No significant change		No significant change		53,776	0	0	53,776
Change					+36,971	-12,884	-26,328	- 2,241

Source: Research Triangle Institute.

*Consumption is assumed to decrease 4 percent due to the higher cost of convenience with a high tax.

raised using 1969 beverage consumption levels, or $385 million using 1976 trend levels. This rapid increase in tax revenues is due to the continuing trend toward nonrefillable containers. Since the tax is on the container, not the filling, these containers generate most of the revenues. These revenues, if devoted to collecting littered beverage containers could increase collection frequencies about 5 times thereby resulting in a cleaner environment.

There are several reservations that must be made. One is that the revenues might merely substitute for present funds and would not result in a cleaner environment. This possibility, while undesirable, would at least cause the most offensive part of litter to pay for its own removal. Such a substitution could be taken to indicate that a cleaner environment does not rate very highly as a government priority and to indicate that government officials believe that sufficient funds are now being expended. A second reservation is that even with more frequent litter collections, all types of litter rather than just beverage containers would undoubtedly be picked up. We cannot expect to see 5 times fewer littered beverage containers simply because the revenues raised by a tax on beverage containers are 5 times greater than the beverage container share of litter costs, because it would be impractical as well as inefficient to pick up beverage containers without picking up all types of littered items.

The high tax produces substantially different impacts on litter. Since we expect a high tax imposed by the government to be accompanied by a voluntary increase in deposits on refillables by the beverage distributors in order to keep convenience-minded customers from discarding them, the rate of littering should be substantially reduced. Many of those that continue to be littered might be scavenged for their deposit value. Also, the tax on beverage containers, assuming a 4 percent decrease in consumption and a trippage of 15, would raise approximately $265 million with 1969 consumption, or $324 million for 1976, that could be used to increase the frequency of litter collection about 5 times. The revenues from a high tax do not rise as rapidly as those from a low tax because the high tax is expected to result in a refillables-only system and the revenue increases then become directly tied to consumption rather than the changing mix of container types and consumption. As a result, revenues from a high tax are greater than those from a low tax for 1969 but less for 1976.

(b) Beverage container element of solid waste.

The low tax will not significantly change the number of containers discarded. The high tax will reduce the beverage container share of solid waste to mostly the broken refillable bottles, many of which would probably be recycled since most of the breakage would occur at the bottling plants.

(c) Solid waste managment costs of beverage containers.

There would be no change in solid waste collection and disposal costs under a low tax since no significant changes are expected in beverage consumption or containerization. Litter collection costs would increase if the revenues were spent on increased collection frequencies. The increased expenditures, however, would not be financed out of the ordinary tax sources.

The high tax, with virtually no littering of beverage containers expected because of the anticipated voluntary increase in deposits, could save $43 million that was spent for the collection of littered beverage containers in 1969 The potential savings estimated for solid waste are $93.3 million for 1969, again assuming a linear relationship between the beverage container share by weight and the collection and disposal costs.

4.2.6.3 Costs. The costs to the beverage industries and consumers of a low tax are fairly small since only small changes are expected in beverage prices, consumption, and containerization. The high tax has substantial costs in terms of beverage prices, cost of convenience, employment, investment, tax revenues, and personal income.

(a) Beverage prices.

The low tax increases the price of beer in nonrefillable bottles and cans by about 2.3 percent and soft drinks by about 3.5 percent. Prices of beverages in refillable containers would probably not be significantly affected.

The high tax would initially increase beverage prices in nonrefillable bottles and cans by about 23 percent for beer and 34 percent for soft drinks. As indicated above, these increases are expected to cause a shift to an all-refillables system where beer prices would increase by 2 percent and soft drinks by 3 percent.

These figures are national averages. In some sections of the nation, beer in refillable bottles may increase substantially more in price due to higher transportation costs.

(b) Cost of convenience.

Consumers paid $598.4 million in 1969 and are projected to pay $1,150 million by 1976 for the convenience of not having to return empty beer and soft drink containers. With the tax, the cost of convenience will increase by the amount of the tax. As shown in Table 29 the low tax will increase the amount consumers would have to pay by $208 million for the 1969 consumption rate and $379 million in 1976 to maintain convenience. Under the high tax, consumers would have to pay an additional $1,613 million for the 1969 consumption rate and $2,867 million in 1976 to maintain convenience. As discussed above, consumers are not expected to pay this higher cost of convenience under a high tax; rather a switch to refillable bottles is expected.

(c) Employment.

Since no substantial changes in beverage consumption or containerization are expected with a low tax, employment will be unaffected.

The net employment effects of a high tax are expected to be an increase of about 300 jobs (1969 rate) with the all-refillables system and the expected 4 percent decrease in consumption. The largest employment losses are expected in the container manufacturing industries. The gains are expected in the beverage producing, distribution, and retailing industries due to the

Table 29. COST OF CONVENIENCE IMPACTS ESTIMATED WITH A TAX ON BEVERAGE CONTAINERS

	Low tax (0.5 cents)		High tax (5.0 cents)	
	Per filling	Total (millions)	Per filling	Total (millions)
1969				
Beer				
Actual*	1.0¢	$235.9	1.0¢	$ 235.9
Expected outcome†	1.5¢	353.8	5.3¢	1,250.3
Change	+0.5¢	+117.9	+4.3¢	+1,014.4
Soft drinks				
Actual*	2.0¢	$362.5	2.0¢	$ 362.5
Expected outcome†	2.5¢	453.1	5.3¢	960.7
Change	+0.5¢	+90.5	+3.3¢	+598.2
1976				
Beer				
Trend*	1.0¢	$365.9	1.0¢	$ 365.9
Expected outcome†	1.5¢	548.8	5.3¢	1,939.1
Change	+0.5¢	+182.9	+4.3¢	+1,573.2
Soft drinks				
Trend*	2.0¢	$784.2	2.0¢	$ 784.2
Expected outcome†	2.5¢	980.2	5.3¢	2,078.2
Change	+0.5¢	+196.0	+3.3¢	+1,294.0

Source: Research Triangle Institute.

*Current price differential between beverage in refillable and nonrefillable bottles.

†This is the amount all consumers who had purchased or are projected to purchase their beverages in nonrefillable bottles and cans without the tax would have to pay to maintain convenience under these tax rates.

higher labor requirements of a refillables system. These are shown in Table 30.

(d) Investment.

The investment impacts of a low tax are expected to be

Table 30. EMPLOYMENT IMPACTS ESTIMATED WITH A HIGH TAX (5 CENTS) ON BEVERAGE CONTAINERS
(thousands)

	1969			1976		
Industry	Actual	Expected outcome*	Change	Trend	Expected outcome*	Change
Soft drink	128.6	141.2	+12.6	147.7	178.6	+30.9
Malt liquor	58.1	61.3	+ 3.2	62.0	69.3	+ 7.3
Wholesale beer	59.9	74.5	+14.6	70.9	93.0	+22.1
Retailing	19.6	50.0	+30.4	11.1	60.9	+49.8
Glass containers	71.5	55.8	-15.7	76.8	43.9	-32.9
Metal cans	68.1	38.6	-29.5	86.3	39.1	-47.2
Metals	617.7	602.4	-15.3	617.7	593.1	-24.6
Total	1,023.5	1,023.8		1,072.5	1,077.9	
Gain			+60.8			+110.1
Loss			-60.5			-104.7
Net			+ 0.3			+ 5.4

Source: Research Triangle Institute.

*Beer and soft drink consumption is assumed to decrease 4 percent due to the higher cost of convenience with a high tax.

negligible or nonexistent. The impacts under a high tax would be significant. As shown in Table 31, they are estimated at $1.4 billion in writeoffs. New investment of about $1.2 billion would be necessary to convert to a refillables-only system based on the Midwest Research Institute data provided for various levels of consumption.

(e) Tax revenue.

The impacts on tax revenues will only be significant for a high tax. The revenue losses would be the same as those estimated for a mandatory high deposit, i.e., about a $51-million reduction in beer excise tax revenues due to the lower consumption expected and tax writeoffs of $1.4 billion or $271 million annually over a 5-year period. See Table 32.

Table 31. INVESTMENT IMPACTS ESTIMATED WITH HIGH TAX (5 CENTS) ON BEVERAGE CONTAINERS (millions)

	Total writeoff	New investment*
Soft drinks	$ 181	$ 345
Malt liquor	169	501
Wholesale beer distribution	-0-	298
Retailing	-0-	24
Glass container†	161	-0-
Metal can	550	-0-
Metals	300	-0-
Total	$1,361	$1,168

Source: Jeff Maillie, The National Economic Impact of a Ban on Nonrefillable Beverage Containers, Midwest Research Institute, Kansas City, 1971, pp. 23,73,75,76,78 and Research Triangle Institute.

*These figures are 4 percent lower than the amounts estimated if consumption had remained constant. MRI assumed an 8 percent decline in consumption.

†Trippage of 15; MRI assumed a trippage of 8.

Table 32. BEER EXCISE TAX IMPACTS ESTIMATED WITH A HIGH TAX (5 CENTS) ON BEVERAGE CONTAINERS

	Consumption (million barrels)	Tax* (million)
1969		
Actual	114.9	$1,551.2
Expected outcome	111.1	1,499.9
Change	-3.8	-51.3
1976		
Trend	145.5	$1,964.3
Expected outcome	140.7	1,899.5
Change	-4.8	-64.8

Source: Research Triangle Institute

*Based on Federal excise tax of $9.00 per barrel and an average State excise tax of $4.50 per barrel.

Table 33. PERSONAL INCOME IMPACTS ESTIMATED WITH A HIGH TAX (5 CENTS) ON BEVERAGE CONTAINERS
(millions)

Industry	1969			1976		
	Actual	Expected outcome	Change	Trend	Expected outcome	Change
Soft drink	$834.1	$915.8	+$81.7	$956.0	$1,158.4	+$202.4
Malt liquor	578.8	610.7	+ 31.9	617.6	690.4	+ 72.8
Wholesale beer	470.7	585.4	+114.7	557.1	730.8	+ 173.7
Retailing	113.8	290.1	+176.3	64.4	353.6	+ 289.2
Glass containers	189.4	75.5	-113.0	317.1	78.4	- 238.7
Metal cans	260.0	0	-260.0	416.4	0	- 416.4
Metals	144.7	0	-144.7	233.0	0	- 233.0
Total	$2,591.5	$2,477.5		$3,161.6	$3,011.6	
Gain			+$404.6			+$738.1
Loss			-$518.6			-$888.1
Net			-$114.0			-$150.0

(f) Personal income.

Personal income losses and gains would be significant only for the high tax since only this tax is expected to cause large employment shifts. As shown in Table 33, until the displaced workers could find new jobs, there would be a $114 million reduction in personal income (1969 rate) annually since the created new jobs, although more numerous than those lost, would be lower paying.

4.2.6.4 Equity. A nonrefundable tax on beverage containers falls on all beverage consumers regardless of whether or not they litter empty containers. The purchasers of beverages in refillable containers, however, bear the smallest portion of the costs since the prices of beverages in these containers would increase the least.

Equity could be improved if the tax were refundable to those who did not litter. This would require the consumer to return the empty container to a reclamation center. The operators of the reclamation center would receive the revenue from the government upon evidence of having recycled the containers. The reclamation center could use some part or all of the tax refund to encourage consumers to return empty containers.

4.2.6.5 Administration. A tax on beverage containers could be administered on a Federal, State, or local level.

All States and the District of Columbia currently tax beer and several States tax soft drinks. Therefore, a large part of the necessary administrative machinery for collecting the tax is already available. For States which are not currently taxing soft drinks, the general procedures used for collecting beer taxes can be applied. The most common procedure used is for wholesalers to report beer sales and pay the tax in the month following the sales. In some States, however, the taxes are paid by crowns, lids, or stamps. The wholesaler prepays the tax to the State revenue department which either issues stamps or informs the crown or lid producing firm to release the closures to the wholesalers. The crowns or lids usually carry a statement indicating that the tax has been paid. This procedure, since it requires prepayment, ties up wholesalers' money. In recognition of this and also of the administrative burden placed on wholesalers, a discount of 1 to 3 percent of the taxes is usually allowed. However, most States have gone to the reporting system with only Alabama, Georgia, Mississippi, and West Virginia expected to have the crowns and lids system by the end of 1972.

A tax on the container would be a slight departure from present practices but if employed on the State level should present no significant administrative problem. The container manufacturers would act in the same manner as crown or lid manufacturers currently do. They would receive a release to ship containers to the brewers or bottlers from each State's revenue department. A distinctive marking might be put on the container as evidence that tax had been paid.

Disbursement of tax revenues to local areas for increased frequency in litter collection has parallels in current revenue sharing practices of government. The Federal government allocates revenues to States and local areas for education and many other special purposes. States allocate revenues to local areas for education as well as highway needs and other such programs. If desired, the revenues can be earmarked for litter collection. Audits can be used to insure the funds are spent as specified.

4.2.6.6 Type of Mechanism. A tax on beverage containers would probably become part of the price of beverages and, therefore, it would be a market-type mechanism which would insure that the beverage consumers bear the social costs of littered containers. Because beverage prices would increase, there would probably be a reallocation of resources away from beverage containers. The reallocation would be in response to a change in the quantity of beverages demanded as a result of the higher prices which now reflect the social costs of littered containers.

If the tax were refundable, it would encourage the economic recycling of beverage containers. A market would exist because the government would refund the beverage container taxes when the containers were recycled.

4.2.6.7 Type of Approach. A tax on beverage containers could be applied to other items appearing in litter; however, it may not be as easy to apply to them. For example, paper is the largest component of litter, yet it can occur in many forms: a cigarette pack, sheet of newspaper, food wrapers, letters, junk mail, etc. Yet these items are not as finite as beverage containers and, therefore, may be more difficult to tax.

4.2.7 Proposal 7: Subsidies (Incentive)

A third type of incentive is a subsidy. Subsidies include the use of tax credits, accelerated depreciation, tax exemptions, grants, loans, and loan guarantees for the purpose of encouraging recycling. The emphasis of the proposed subsidies has been on recycling and not on the litter and solid waste aspects of beverage containers. The proposed subsidies are intended to improve the economics of recycling and make it a more viable alternative to the use of virgin materials. Although subsidies will reduce the costs, or increase the revenues, of the recycling companies once empty beverage containers are obtained and processed, they are not likely to influence the behavior of the consumer who litters. Unless the subsidies are so large that the recyclers can pay the consumers far more than the small amount that containers are worth as raw materials, the behavior of those consumers who litter is unlikely to be greatly influenced. Smaller payments than those necessary to reduce the rate of littering may suffice, however, to encourage scavenging from litter, and thus lead to a cleaner environment.

The size of the subsidy necessary to encourage scavenging from litter has not been estimated. Subsidies are an inefficient and indirect method of attacking litter. Furthermore, they may not even be the best means to increase recycling. They could cause more resources than are optimal--given current and anticipated free market prices--to go into recycling rather than into virgin materials. They would further distort resource allocation by causing more capital and less labor to go into recycling than would occur without subsidies, since most subsidies operate by reducing the cost of capital equipment. Subsidies also present problems of administration since they are supposed to go to companies that would not have made the expenditures without the subsidy. However, that determination may be difficult. A final aspect is that subsidies would probably have to be nationwide and administered at the Federal level.

4.2.8 Proposal 8: Educational Campaign (Indirect Influence)

The first of three indirect influences is an increased educational campaign against littering designed to persuade consumers to voluntarily reduce littering.

There is little data available on the effectiveness of educational efforts to change people's behavior. About $50 million per year is spent by Keep America Beautiful, Inc. (KAB), chambers of commerce, and other civic organizations to discourage littering; these organizations visit schools, distribute litterbags and litter baskets, and prepare advertising. The impact of this effort is unknown. Despite these efforts, there has been no thorough study to determine why and under what conditions people litter. Such a study would appear to be a requisite first step in a litter prevention program.

The amount of money that will be needed to significantly reduce litter through education is probably much larger than is currently spent. The beverage industries spend substantially more on advertising than is spent on antilittering efforts. Much of the beverage advertising is directed at selling the convenience of nonrefillable beverage containers. The money spent educating people about the dangers of smoking (without eliminating the habit) and encouraging people to use seat belts (without convincing many people) demonstrates the difficulty of changing public behavior. In fact, the group that litters most, according to a Gallup poll,[41] is the 21-35 year olds who have been exposed more than any other group to antilitter messages during their formative years.

The critical point about education of this type is cost-effectiveness, and this cannot be readily determined.

4.2.9 Proposal 9: Enforcing Present Litter Laws (Indirect Influence)

Because littering is illegal in all 50 States, more vigorous enforcement of laws prohibiting litter may be a logical approach. However, littering is done quickly and surreptitiously. To apprehend the roadside litterer in the act of littering would require tremendous numbers of policemen patrolling in automobiles. (Of course, the fear of apprehension would deter many potential litterbugs.) To prosecute and sentence offenders would require substantial increases in the size of the judicial system. With the rate of serious crime rising so rapidly, less and less attention is likely to be given to minor antisocial actions such as littering.

The cost-effectiveness is also questionable. There are about 12 billion items of all types littered per year. If each patrolman could catch and help prosecute (by appearing in court) 10 offenders per day, he might prevent 1000 incidents per day or 250,000 items of litter per year. The cost of training, equipping, supporting, and paying a State patrolman probably is at least $20,000 a year. Thus the cost of prevention would be $0.08 per item, roughly 4 times the current average cost of removal.

4.2.10 Proposal 10: Research and Development (Indirect Influence)

The last proposal (or set of proposals) is research and development (R&D) on various aspects of the littered container problem. R&D efforts would require time and offer no guarantee of a practical solution.

One proposed solution is the development of a beverage container that would disappear soon after it is used or littered but would not degrade before the contents are consumed. Among several possibilities being investigated are a water-soluble glass bottle that would dissolve once the coating was removed (this container seems to be far in the future) and a self-destructive container of plastic that would disintegrate when exposed to the ultraviolet component of sunlight. A new container is likely to cause severe dislocations in the container industry. Such an R&D effort would have to be nationwide rather than statewide or local. There would still be a residue of inert material once the containers disintegrated. This type of container might also encourage littering behavior.

Another R&D proposal is to study the economics of litter removal. Cost relationships are not known. Information is needed, particularly with the respect to the relationship of costs to the organization of resources, to the frequency of pickups, to the type of terrain, and to the type of litter. More frequent pickups coupled with better removal techniques and mechanical equipment might significantly improve the appearances of the environment at a small additional cost. Funds would still be needed to perform the R&D and to implement the results.

Chapter 5: RECOMMENDATION FOR A GOVERNMENTAL POLICY

5.1 Introduction

Government action is justified when three conditions exist: (a) general welfare is being reduced or threatened, (b) individuals and institutions outside government cannot or will not take effective corrective action, and (c) there is an available public policy that may reasonably be expected to be effective, to be equitable, and to provide benefits in excess of its cost. This study has established that litter does reduce the quality of the environment and thereby creates substantial social costs which are borne by all members of society. The beverage container can be identified as the most offensive element in litter. Also, there is every indication that beverage containers will continue to be littered, probably at a substantially greater rate in the future due to growth in beverage consumption and shifts in containerization away from refillable bottles toward the more litter-prone nonrefillable bottle and can.

The market system and private antilitter campaigns do not show signs of eliminating litter, and State and local governments do not have the resources to respond to the demand for a cleaner environment. Additional funds to collect littered containers, if made available from general revenue sources, could lead to a decrease in other expenditures or higher general taxes paid by all members of society. A government policy is therefore justified for dealing directly with the beverage container provided that the cost-benefit relationship and performance in terms of the other criteria justify its implementation. Such a specific policy on the beverage container should not, however, preclude attempts to deal with other littered items.

Examination of the broad policy alternatives leads to the conclusion that neither by imposing restrictions nor by programs using indirect influence would there be any significant probability of reducing the social costs of beverage containers. Incentives, however, do offer a satisfactory alternative. The choice from among the available incentives is between mandatory deposits and a tax on all beverage containers.

Only a deposit level high enough to insure a refillables system of beverage containerization is predictable in terms of benefits and costs. The level of deposit necessary to insure this outcome is unknown. A deposit level of 10 cents has been assumed as necessary to insure this outcome. The actual level necessary may be somewhat lower or higher depending on geographic location.

Two tax levels were analyzed, a low of 0.5 cents and high of 5.0 cents. The low tax seems more desirable than the high tax, at this time, because the high tax, without provisions for refundability, raises beverage prices and generates revenues substantially in excess of the amounts necessary to collect the containers that continue to be littered. The mandatory high deposit and the low tax are compared in the next section.

This chapter concludes with a recommendation for a governmental policy on the beverage container problem.

5.2 Evaluation of a Mandatory High Deposit and a Low Tax

5.2.1 Predictability

Both a mandatory high deposit and a low tax on containers have reasonably predictable impacts on beverage prices and containerization. The impact of the tax on consumption can also be predicted, but the impact of a mandatory deposit on consumption is much less certain because of the lack of information available on the demand for convenience. The impact on consumption, however, is expected to be substantially greater with a mandatory high deposit than with a low tax since the high deposit significantly raises the price of convenience.

5.2.2 Benefits

Both the mandatory high deposit and low tax would subtantially reduce the population's exposure to littered containers, but by different approaches. The high deposit is expected to greatly reduce littering and possibly stimulate scavenging while the tax is expected to generate funds to permit more frequent collection of littered containers. The mandatory high deposit will probably result in an environment with fewer littered beverage containers than will the tax. However, no direct comparison between the two policies is possible because of insufficient information on current collection frequencies and the number of littered containers seen annually by the population. The low tax will result in a cleaner environment _if_ the revenues are used for improved litter collection, but there will still be beverage containers on the ground at some times, because pickups would be made at intervals rather than continuously. The tax offers the advantage that other items could be picked up along with the beverage containers, whereas the deposit will eliminate beverage containers from litter but not affect the other items.

At 1969 rates, the mandatory deposit could save about $43 million in litter collection costs and about $93 million in solid waste costs assuming the proportional relationships discussed in Chapter 3. The tax will generate revenues of $219 million that can be used to do a better job of collecting litter but would not affect solid waste costs.

5.2.3 Costs

5.2.3.1 Beverage Prices. A tax will cause prices of beverages in nonrefillable bottles and cans to increase by the amount of the tax, while beverages in refillables should be unaffected since the tax would be distributed over several fillings.

The mandatory high deposit will probably result in lower _average_ prices for beverages since nonrefillable bottles and cans are expected to be no longer available.

5.2.3.2 Cost of Convenience. The mandatory high deposit of 10 cents will raise the cost of convenience about 9 cents for beer and 8 cents for soft drinks over what consumers are currently paying. The low tax of 0.5 cent would raise the cost of convenience by the amount of the tax, 0.5 cent, for both beverages. Although there are no data available to calculate the loss in consumer welfare as a result of a higher cost of convenience, the losses due to a mandatory high deposit are anticipated to be substantial.

5.2.3.3 Employment. The mandatory high deposit and consequent shift to an all-refillables system will cause a reduction of 60,500 employees (based on 1969 figures) in some industries and an increase of 60,800 in other industries connected with beverages. The large shifts may cause temporary unemployment and other hardships in the affected areas. The low tax will not cause significant employment changes in the beverage industries but may cause an increase in litter collection employment.

5.2.3.4 Investment. The low tax is not expected to affect investment. The mandatory high deposit, however, may result in tax writeoffs of $1.4 billion of equipment made obsolete by the expected shifts to an all-refillables system. This shift will require new investment of about $1.2 billion.

5.2.3.5 Tax Revenues. The mandatory high deposit will reduce beer excise tax revenues about $51.3 million (1969) due to the expected 4 percent drop in beer consumption. This would be an annual loss of about $34 million on a Federal level and an average of $340,000 for every State. There will also be tax writeoffs of $1.4 billion, or $271 million annually over a 5-year period.

5.2.3.6 Personal Income. The employment shifts caused by the mandatory high deposit will result in a net loss of income for persons employed in the affected industries. This is because the refillables system is more economical. This means that beverage consumers will not have to pay as much for these beverages and may use these excess funds to make other purchases. These purchases will then generate personal income in other industries. The low tax will not significantly affect personal income.

5.2.4 Equity

Both a mandatory deposit and a tax would be inequitable to a degree, in that the burden would fall on all beverage consumers, not just those that litter their empty containers.

5.2.5 Administration

Both mechanisms are relatively easy to administer with the tax being the easier. One weakness of the high deposits is the possible migration of containers from low- to high-deposit areas. Spot checks would have to be made to insure that the proper deposits were being collected and refunded. The collection of the tax can probably be handled easily with procedures existing in most States. Allocation of the funds to promote better litter collection might be a greater problem. The difficulty is to insure that the funds are actually used for litter collection, and are a net addition to existing expenditures for this purpose.

5.2.6 Type of Mechanism

Both a tax and a mandatory deposit are market-type mechanisms which will be included in the price of the beverage.

5.2.7 Type of Approach

The tax appears to have more potential applications to environmental problems, especially litter, than a deposit.

5.2.8 Summary

In terms of the costs and benefits of the low tax and mandatory high deposit, the deposit probably has greater benefits but its costs are significantly greater than those of a tax. Using only the costs, which are permanent reductions in welfare and not reallocations of economic activity, the comparison is between the incremental benefits of a deposit over a tax (which are not known) and the incremental costs of convenience (about 8 cents per container).

For most of the other criteria (predictability, administration, equity, type of mechanism, type of approach), the tax appears superior to the mandatory deposit.

5.3. Recommendations for Governmental Policy

It is recommended that a tax on beverage containers be employed to deal with the beverage container problem. The tax should reflect the social costs of littered containers. This policy would be the most predictable, least-cost, most equitable, and easiest of the available alternatives to administer. It may have applicability to other environmental (especially litter) problems.

Since beverage consumption, container types, littering habits, citizen values, and litter collection costs all vary from area to area, the social costs incurred by society will also vary. For this reason, and also for reasons of administratibility, the tax should be imposed at the State level. Each State should determine its appropriate tax rate, based on the magnitude of its beverage container problem. It appears, however, that most tax rates should be from 0.5 to 1.0 cent per container.

5.4 Recommendations for Further Research

Two additional aspects of the beverage container were considered, but the scope of this study precluded their complete evaluation.

First, refundable taxes on products may be an effective way to encourage solid waste recycling, thereby reducing the solid waste management burden. Such taxes could be refunded to organizations which demonstrated that they had reused or recycled a potential waste product. The recycling organization could use the rebate from the government as a basis for providing an incentive to consumers to return products for recycling. For example, the aluminum companies currently pay about 0.5 cent for every aluminum can received from consumers. If the companies received from the government the tax paid by the consumer--say, 0.5 cent--they could offer about 1 cent per can, thereby encouraging still more consumers to return their empty aluminum cans for recycling. The administratibility of such a proposal is, however, unknown and would have to be studied.

Second, the environmental implications of discarded beverage container closures or the packaging used when several containers (for example, the six-pack) are sold together have not been explicitly examined. Most consumers probably do not routinely litter their empty beverage containers, but they may routinely litter the containers' closures. These closures, such as bottle caps, pull-tabs, or tear rings may cause insidious, long-term impact on the environment due to their ubiquitous nature and the difficulties involved in collecting them.

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Appendix A: PENDING LEGISLATION

A.1 Introduction

The United States Brewers Association has provided tabulations of the pending legislation on beverage containers. The legislative proposals as of June 1971 are summarized in Table A-1, and listed in Table A-2.

Table A-1. SUMMARY OF LEGISLATION FOR CONTROLLING BEVERAGE CONTAINERS, 1969-71, BY CATEGORIES

Category	Number of bills*		
Prohibition of Containers	213		
Total Nonreturnables		172	
Nonreturnable Glass			18
Nonreturnable Metal			10
Any Nonreturnables			144
Aluminum Content		6	
Polyvinyl Chloride Content		4	
Nondestructibles		12	
Nondegradable			3
Nonbiodegradable			8
Noncombustible			1
Disposal Unless Recyclable		5	
Pull-Tops		5	
Sold in Vending Machines		1	
Other		8	
Regulations	174		
Deposits and Refunds		93	
2 cents			8
3 cents			2
4 cents			3
5 cents			46
6 cents			2
10 cents			7
Amount not Specified			25
Recycle or Reclaim		7	
Tax		67	
Tax Level:			
On Manufacturer			3
On Wholesaler			15
On Retailer			10
Type of Container:			
Aluminum			1
Beer			3
Soft Drink Bottles			2
No-Deposit Bottles			2
Nonreturnable			40
Returnables			1
All Containers			4

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Table A-1 (continued). SUMMARY OF LEGISLATION FOR CONTROLLING BEVERAGE CONTAINERS, 1969-71, BY CATEGORIES

Category	Number of bills*		
Amount of Tax:			
1/4 cent			1
1/2 cent			1
1 cent			20
2 cents			5
3 cents			1
5 cents			8
10 cents			2
1-3 cents			2
Fine or Imprisonment		4	
Permits to Sell		3	
Study Committees (R&D)	41		
Degradable Package Development		3	
Recycle Process		12	
Nonreturnables		10	
Environmental Improvement		16	

*Total number of bills in this table is greater than total bills presented in Table A-2 since many bills specified more than one category of control.

Table A-2. PENDING LEGISLATION: SELECTED STATE AND FEDERAL LAWS PROPOSED AS OF JUNE 1971*

Legislative body	Bill	Characteristics
U.S. Congress	H.R.399	Establishes a Joint Congressional Committee on Environmental Quality.
	H.R.665	Provides for a study of the decomposability and destructibility of packaging and other materials.
	H.R.948	Bans beer and soft drink containers that are sold in interstate commerce on a no-deposit, no-return basis.
	H.R.1083	Establishes economic incentives by industrial accessed disposal charges for development of degradable packaging and for recycling.
	H.R.1149	Levies an excise tax of 2¢ to 25¢ on nonreturnable glass or plastic containers of beer, soft drinks, and alcohol.
	H.R.1214	Prohibits the sale and manufacture for sale in interstate commerce of all nonreturnable beer and soft drink containers.
	H.R.2360	Provides for a study of measures to accelerate the reclamation or recycling of materials from solid wastes.
	H.R.3138	Prohibits the sale, manufacture for sale, or delivery in interstate commerce of soft drink and beer nonreturnable containers.
	H.R.3275	Requires distilled spirits, wine, and beer be sold in reusable containers.
	H.R.3361	Prohibits the sale, manufacture for sale, or delivery in interstate commerce of soft drink and beer nonreturnable containers.
	H.R.3362	Same as H.R.3361.
	H.R.4985	Same as H.R.3361.
	H.R.5283	Same as H.R.3361.
	H.R.5451	Discourages production of one-way containers for soft drinks and beer.
	H.R.6255	Same as H.R.3361.
	H.R.6806	Provides for incentives for demonstration of resource recovery systems.
	H.R.6859	Provides grants for construction of resource recovery systems and for solid waste disposal facilities.
	H.R.6975	Same as H.R.1149.

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*From United States Brewers Association, Summary of Proposed Legislation, January 1971 and June 1971.

Table A-2 (continued)

Legislative body	Bill	Characteristics
U.S. Congress (cont.)	H.R.8005	Provides for Federal procurement of products manufactured from recycled materials.
	H.R.8006	Same as H.R.8005.
	H.R.8151	Establishes a national system of solid waste management.
	H.R.8370	Imposes a retailers' excise tax on nonreturnable beer and soft drink cans.
	H.R.8960	Prohibits interstate commerce of nonreturnable beverage containers on which there is no reasonable money deposit.
	H.R.9083	Same as H.R.8960.
	H.R.9297	Imposes a retailers' excise tax on nonreturnable bottles and cans.
	H.Res.39	Creates a House Standing Committee on the Environment.
	H.Res.42	Same as H.Res.39.
	H.Res.51	Same as H.Res.39.
	H.Res.174	Same as H.Res.39.
	H.J.Res.260	Same as H.R.339.
	H.J.Res.434	Same as H.R.339.
	S.282	Requires national standards and charges for packaging that is not easily disposable or is not recycled.
	S.1377	Requires reasonable refundable money deposit on any nonreturnable beverage containers in interstate commerce.
	S.J.Res.14	Amends the Constitution to provide for "right to a decent environment".
	S.J.Res.15	Designates "Earth Week".
	S.J.Res.17	Establishes a joint congressional committee on the environment.
	S.J.Res.22	Designates "Cleaner Air Week".
Alaska	H.B.183	Imposes a tax of 1/20 of 1% of gross receipts of manufacturers, wholesalers, and retailers of beer and other products.
	S.B.77	Requires a minimum 5¢ deposit on all beer and soft drink containers.
	S.B.87	Imposes a 1¢ tax on paper or metal beverage containers, and a 2¢ tax on glass or plastic containers.
	S.B.130	Same as H.B.183.
Arizona	H.B.39	Imposes a tax of 10¢ per 12 oz. on nonreturnable soft drink and malt liquor containers.
	H.B.164	Prohibits the sale and distribution of alcoholic and nonalcoholic beverages in nonreturnable tab-top containers.
	S.B.40	Prohibits the sale of alcoholic and nonalcoholic beverages in nonreturnable containers

Table A-2 (continued)

Legislative body	Bill	Characteristics
Arizona (cont.)	S.B.74	Requires a deposit of 2¢ to 10¢ on all beer and soft drink containers.
	S.B.90	Requires a 10¢ deposit on all beer and soft drink containers except paper.
Arkansas	H.B.5	Requires a 5¢ deposit on all beer, soft drink and liquor containers.
	H.B.34	Requires a 1¢ tax on nonreturnable soft drink and beer containers.
	H.C.Res.26	Urges regulation or restriction of nonreturnable beverage containers.
	H.B.635	Requires a 5¢ deposit on all beer and soft drink containers except paper.
	S.B.25	Imposes a 5/6 of 1¢ tax on nonreturnable metal soft drink and beer containers.
California	A.B.163	Prohibits the sale of beer and soft drinks in nonreturnable containers.
	S.B.118	Requires a 5¢ deposit on all beer and soft drink containers unless the container is biodegradable.
	S.B.213	Imposes a 1¢ tax on each nonreturnable beverage container.
Colorado	H.B.1263	Requires a 5¢ deposit on all beer and soft drink containers.
	S.B.62	Prohibits the sale of products in disposable materials containers unless producer files plan for recycling or reuse of the materials.
	S.B.100	Requires beer and soft drink containers be part of a recycling or reusing program.
Connecticut	H.B.5035	Creates a committee to study banning or taxing the use of nonreturnable containers.
	H.B.5450	Bans the use of nonreturnable, nondegradable containers for beer and carbonated beverages.
	H.B.5809	Bans the use of nonreturnable, nonbiodegradable beverage containers.
	H.B.5810	Requires a minimum 5¢ deposit on nonbiodegradable beer and soft drink containers, and a 1¢ tax on nonreturnable, nonbiodegradable beverage containers.
	H.B.5812	Prohibits nonreturnable beverage containers which are nondegradable or noncorrosive.
	H.B.6595	Provides for a committee to study the problem of disposable containers.
	H.B.7898	Requires the retail sale of milk and noncarbonated soft drinks be in returnable, reusable bottles.
	H.B.8652	Prohibits the retail sale of beer, soft drinks and milk in nonreturnable containers.
	H.B.8807	Prohibits the sale of beverages in nonreturnable bottles.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Connecticut (cont.)	S.B.16	Prohibits the sale of beverages in nonreturnable glass bottles, or noncorrosive cans.
	S.B.136	Prohibits the use of nonreturnable, nondegradable beverage bottles.
	S.B.307	Establishes a committee to study the feasibility of banning or taxing nonreturnable cans and other containers.
	S.B.389	Requires a tax on nonreturnable beverage bottles of 2¢ to 5¢.
	S.B.1646	Prohibits the sale of nonreturnable or nonbiodegradable beverage containers.
Delaware	H.B.5	Requires a deposit of 2¢ on beer, soft drinks, and fruit juices in glass, metal, and plastic containers.
	H.B.101	Prohibits the sale of soft drinks and beer in nonreturnable containers.
	S.B.156	Requires a tax of 1¢ on each 16 oz. of soft drinks sold in a bottled container.
	H.B.322	Requires a 5¢ deposit on beer and carbonated beverages sold in hermetically sealed nonreturnable containers.
Florida	H.B.499	Requires a tax of 1/2¢ on each can and nonreturnable bottle of beer and carbonated beverages.
	H.B.1616	Requires a 2¢ deposit on glass and metal containers of soft drinks, beer, and wine.
Georgia	H.B.919	Prohibits sale of beverages in nonreturnable glass bottles unless there is a monetary deposit on containers.
Guam	Bill #444	Prohibits the sale, manufacture or use of nonbiodegradable containers for soft drinks and beer.
Hawaii	H.B.88	Provides for counties to make arrangements for removal and recycling of metal trash.
	H.B.89	Prohibits the sale of nonreturnable glass, plastic, or metal beverage containers which have no reasonable money deposit.
	H.B.232	Prohibits the sale, furnishing or offering for sale of aluminum containers for any purpose.
	H.B.278	Provides for a deposit of 3¢ on glass containers and 1¢ on cans; also a retailer tax credit of 5% of the gross sales price of a ton of returned glass or can containers, if such are stored until claimed.
	H.B.298	Prohibits the sale, furnishing or offering for sale of aluminum beverage cans.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Hawaii (cont.)	H.B.300	Prohibits all nonreturnable beverage containers on which no reasonable money deposit is required.
	H.B.1458	Levies a 5¢ surfharge on each nonreturnable container.
	H.B.1468	Levies a tax of 5¢ on each nonreturnable glass, metal or plastic container.
Idaho	H.B.230	Provides for a tax of 1¢ on each 7 oz of soft drinks or beer sold in nonreturnable containers. Minimum deposit of 2¢ on returnables.
Illinois	H.B.1117	Requires a minimum 10¢ deposit on all beer, soft drink and liquor containers.
	H.R.1135	Creates a commission on recycling to study reduction of waste.
	H.R.2656	Provides for a Pollution Control Board to regulate the sale or use of containers which would create an unreasonable burden on disposal.
Indiana	H.B.1360	Requires a 4¢ deposit on all beer and soft drink containers.
Iowa	H.F.78	Requires a 10¢ deposit on noncombustible, nonreturnable containers, and prohibits no-deposit, no return containers.
	H.F.313	Prohibits the sale of only American beer and soft drinks in nonreturnable containers.
	H.F.485	Prohibits sale or distribution of nonreturnable beer or soft drink containers.
	S.B.162	Imposes a 1¢ tax on each beverage can or nonreturnable beverage bottle.
Kansas	H.B.1070	Prohibits sale of beverages in nonreturnable or disposal containers.
	H.B.1317	Levies a 1¢ tax on each nonreturnable beer and soft drink container.
	S.B.272	Prohibits the sale of beer and soft drinks in nonreturnable glass or metal containers.
Louisiana	S.C.Res.104	Provides for a joint legislative committee for problems created by disposal containers.
Maine	H.B.76	Requires a 10¢ refund on any bottle in which beer, soft drinks, fruit juices, vegetable juices or mineral waters are sold.
	H.B.397	Permits the sale of malt liquor in kegs.
	H.B.940	Requires a 4¢ deposit on beer and soft drink containers.
	H.B.1303	Directs the Legislative Research Committee to study nonreturnable containers, pending legislation, and determine whether legislation should be adopted.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Maryland	H.B.51	Prohibits the sale, distribution, manufacture, or use of beer, soft drinks, fruit juices or mineral water in nonreturnable containers.
	H.B.224	Imposes a 5¢ tax on nonreturnable beer and soft drink containers which do not have a minimum 5¢ deposit.
	H.B.492	Allows political subdivisions to levy a 5¢ tax on nonreturnable beverage containers.
	H.B.642	Requires that all containers not made of glass or metal be completely biodegradable.
	H.B.643	Requires that all metal and glass products sold after 1/74 be composed of twice the amount reclaimed materials as in 12/71.
	H.B.1295	Requires retailers to offer for sale the same type of beverages in returnable containers as are available in nonreturnable containers.
	S.B.40	Requires a minimum 5¢ deposit on all beer, fruit drink, mineral water, and carbonated beverage containers.
	S.B.460	Same as H.B.643.
	S.B.461	Requires all nonmetal or glass containers be biodegradable.
	S.B.762	Requires retailers to offer under substantially the same conditions, the same beverages in returnable containers offered in nonreturnable containers.
	S.Res.87	Requests all State facilities to use returnable bottles whenever possible.
Massachusetts	H.B.593	Authorizes municipalities to impose a maximum 2¢ surcharge on nonreturnable plastic or aluminum beverage containers.
	H.B.696	Requires a minimum 10¢ deposit on all glass or metal beer and carbonated beverage containers.
	H.B.697	Requires a deposit of 2 to 5¢ on all beverages in nonreturnable glass containers.
	H.B.899	Same as H.B.696.
	H.B.1485	Prohibits the sale or distribution of soft drinks and malt beverages in nonreturnable bottles.
	H.B.1486	Prohibits the sale or distribution of soft drinks and malt beverages in cans or nonreturnable bottles.
	H.B.1487	Requires a 2¢ deposit on soft drink and malt beverage bottles.
	H.B.1488	Requires a 2¢ deposit on soft drink and malt beverage cans or bottles.
	H.B.1489	Prohibits the sale or storage for sale of any beverage in nonreturnable glass containers.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Massachusetts (cont.)	H.B.2927	Imposes a tax of a vendor's gross receipts from the retail sales of beverages in nonreturnable glass or metal containers (minimum 10¢ deposit for returnables).
	H.B.2969	Prohibits the sale of beer or carbonated beverages in metal, plastic, or glass nonreturnable containers.
	H.B.3170	Prohibits the sale of any soft drink in nonreturnable bottles or nonrecycleable cans.
	H.B.3364	Requires 5¢ deposit on all sealable containers of nonalcoholic and malt based beverages except fruit juices or dairy products.
	H.B.4516	Imposes an excise tax of 2¢ for each nonreturnable beverage container, exempting milk, water, and fruit and vegetable juices.
	H.B.4554	Prohibits the sale of beer and soft drinks in nonreturnable glass and metal containers.
	H.B.4704	Requires 1¢ excise tax on each nonreturnable bottle or aluminum can sold.
	H.B.4757	Prohibits the sale of carbonated beverages and beer in nonreturnable glass or metal containers.
	H.B.4906	Provides for 2¢ to 6¢ excise tax on each nonreturnable bottle or can which is nonbiodegradable.
	H.B.5321	Increases the scope of a special commission established to investigate the study the reuse of solid waste.
	S.B.279	Prohibits the sale of carbonated beverages or beer in nonreturnable glass or metallic containers (minimum 10¢ deposit).
	S.B.285	Same as S.B.279.
	S.B.323	Bans the use of nonreturnable bottles in wholesale or retail sales.
	S.B.330	Bans all closed packaging containers of all metal, glass, or plastic that are not redeemable or part of a planned recycling process.
	S.B.1151	Permits the taxation of nonreturnable containers.
	S.B.1153	Imposes a 1¢ tax per pound on nonreturnable packaging or containers.
Michigan	H.B.4152	Requires merchants that sell a brand of beer or soft drinks to redeem that brand's returnable bottles.
	H.B.4159	Requires wordage on beverage or food containers: "Litter costs tax dollars--please put this container in a trash receptable."

Table A-2 (continued)

Legislative body	Bill	Characteristics
Michigan (cont.)	H.B.4170	Requires a minimum 6¢ deposit on all glass beer and soft drink containers.
	H.B.4685	Requires a minimum 10¢ deposit on all sealed beer and soft drink containers.
	S.B.69	Levies a 1¢ tax on glass, tin, steel, and aluminum containers in which any drink, commodity, or product is sold.
	S.B.214	Requires a 10¢ deposit on all soft drink and beer containers.
	S.B.329	Requires a minimum 6¢ deposit on all beer and carbonated beverage bottles.
	S.Res.20	Bans the sale of beer in disposable containers.
Minnesota	H.B.243	Requires a 5¢ minimum deposit on all beer and soft drink containers.
	H.B.382	Requires 5¢ deposit on sealed containers of beer, soft drinks, and liquor.
	H.B.673	Prohibits nonreturnable containers of 10% or more aluminum.
	H.B.1031	Prohibits the sale of beer and soft drinks in nonreturnable cans (minimum 5¢ deposit).
	H.B.1054	Requires 5¢ deposit on glass bottles containing beverages and food products.
	H.B.1865	Requires a 5¢ minimum fee to be paid by both the retailer and the consumer for each container of soft drinks or beer sold. Also prohibits nonreturnable beer and soft drink containers.
	H.B.2777	Requires 5¢ deposit on soft drinks and beer in glass, plastic or aluminum containers.
	H.B.2874	Creates a 10-member commission to study economic methods of recycling waste products.
	S.B.281	Requires 5¢ deposit on all beer and soft drink containers.
	S.B.634	Same as H.B.382.
	S.B.761	Same as H.B.673.
	S.B.1228	Same as H.B.1865.
	S.B.1295	Same as H.B.1054.
	S.B.1296	Same as H.B.1031.
	S.B.2635	Same as H.B.2874.
Mississippi	H.B.238	Levies a 2¢ tax on nonreturnable beer containers, 1¢ on nonreturnable soft drink containers, and 5¢ on the cartons for beer and soft drinks.
	H.B.337	Requires a minimum 5¢ refund on any container in which beer, mineral water, carbonated beverages, or soft drinks are sold.
	H.B.338	Requires 2¢ tax on nonreturnable soft drink containers.
	H.B.349	Increases beer excise tax 10.67 cents per gallon for use by the State Highway Department.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Mississippi (cont.)	H.B.363	Prohibits manufacturers and distributors of soft drinks and beer of 4% or less alcohol from using any nonreturnable containers.
Missouri	H.B.92	Levies 1¢ tax on all nonreturnable aluminum beverage containers for each 24 oz.
	H.B.184	Prohibits the sale or distribution of any beverage in a sealable metal container, excepting steel or tin-plated steel.
	H.B.251	Requires 5¢ minimum deposit on beer and soft drink containers.
	H.B.460	Requires 5¢ deposit on all beer, soft drink, and milk containers.
	H.B.658	Creates a Division of Solid Waste Management to order public agencies to use recycled materials and ban the use of nonreturnable containers.
	H.B.834	Requires a 1¢ tax on sealed containers of soft drinks and intoxicating beverages of 1-1/2 gal. or less.
	H.B.971	Requires standards and materials for use in nonreturnable beverage containers be set by the Conservation Commission.
	H.B.983	Levies a 5¢ tax on any nonreturnable container that would not degenerate within three years.
Montana	H.B.124	Requires a minimum deposit of 2¢ on glass, metal, and plastic containers of less than 40 oz. in which beer, soft drinks, and fruit drinks are sold.
	H.B.585	Levies a tax of $1.20 on each case of 24 no-deposit containers of 26 oz. or less of beer or soft drinks.
	E.H.B.21	Levies a tax of $1.20 on each case of 24 nonreturnable containers of 26 oz. or less of beer or soft drinks.
	S.B.38	Prohibits the sale or distribution of beer, soft drinks or carbonated beverages in nonreturnable containers.
Nebraska	L.B.433	Levies a tax of 1¢ on each nonreturnable glass or metal beer or soft drink container.
	L.B.888	Prohibits the sale of soft drinks, liquor, and beer in any nonreturnable container.
Nevada	H.B.313	Prohibits the sale of beer and soft drinks in cans and disposable containers.
	S.B.22	Prohibits the sale of beer and soft drinks in metal cans with a pull-top tab. Also requires minimum 5¢ deposit for all beer and soft drink containers.
New Hampshire	H.B.63	Provides for a committee on nonreturnable containers.
	H.B.330	Provides for a 5¢ to 10¢ deposit on bottles sold at State liquor stores.

Table A-2 (continued)

Legislative body	Bill	Characteristics
New Jersey	A.B.2212	Requires 5¢ minimum deposit on all beverage containers.
	S.B.2150	Requires 5¢ deposit on beer and carbonated beverage containers sold at retail.
	S.B.2284	Establishes a State Council on Recycling.
New Mexico	S.B.322	Requires 2¢ deposit on beer and soft drink glass or metal containers.
New York	A.B.71	Prohibits the manufacture or sale of soft drinks or beer in cans containing aluminum by-products.
	A.B.183	Requires 5¢ deposit on beer and malt beverage containers.
	A.B.1399	Requires a minimum 5¢ deposit on beer and soft drink containers, which must be recyclable or reusable.
	A.B.1993	Prohibits the sale of beverages in nonreturnable glass containers.
	A.B.2225	Requires beverages containers be biodegradable and have a minimum deposit of 5¢.
	A.B.2343	Gives ahe Commissioner of Public Health the authority to prohibit metal or nonreturnable glass beverage containers.
	A.B.2410	Requires beverage containers be biogradable and have a minimum 5¢ deposit.
	A.B.2413	Prohibits the manufacture and sale of nonreturnable bottles and cans, and the sale of goods in nonreturnable bottles and cans.
	A.B.2510	Requires a minimum deposit of 2¢ on all beverage containers.
	A.B.3492	Prohibits the sale of materials in polyvinyl chloride containers.
	A.B.3596	Beer and soft drink bottle manufacturers shall provide for their recycling.
	A.B.3662	Prohibits the use or sale of nonreturnable bottles or cans.
	A.B.4764	Prohibits production, use, sale, and distribution of beverages in nonreturnable containers, and levies a 10¢ tax on those distributors for containers not returned.
	A.B.5371	Requires levies of 3¢ to 10¢ on disposable food containers.
	A.B.7758	Provides for a 1¢ to 3¢ tax on nonfood containers, with local tax credits and deductions for recyclable and reusable containers.
	S.B.324	Same as A.B.183.
	S.B.1237	Same as A.B.1399.
	S.B.2032	Same as A.B.2225.
	S.B.2076	Same as A.B.2343.
	S.B.2936	Provides that soft drink and beer bottle manufacturers shall provide for the recycling or reuse of such bottles.

Table A-2 (continued)

Legislative body	Bill	Characteristics
New York (cont.)	S.B.3326	Same as A.B.3492.
	S.B.4984	Prohibits nonreturnable beverage containers and levies a 10¢ tax on containers.
	S.B.6634	Same as A.B.7758.
North Carolina	S.B.177	Requires 2¢ deposit on soft drink and beer bottles.
North Dakota	H.C.Res.3035	Urges the use of returnable beer and soft drink containers.
Ohio	H.B.119	Requires 5¢ deposit at first sales level, or 1¢ tax at retail level on beer, soft drink, and dairy products containers.
	H.B.473	Prohibits the sale of soft drinks in nonreturnable or disposable metal or glass glass containers.
	H.B.627	Requires minimum 5¢ deposit on soft drink and beer containers and requires containers be biodegradable.
	S.B.266	Uses economic incentives for reuse and recycling of packaging materials.
Oklahoma	H.B.1456	Levies a 1¢ tax on each can or bottle of beer.
Oregon	H.B.1036	Requires a minimum 5¢ deposit on beer and soft drink containers.
	H.B.1039	Levies a 5¢ tax on nonreusable shipping containers.
	H.B.1949	Levies a 1/4¢ tax on beverage containers that do not have a minimum 5¢ deposit or are not certified. (Excludes milk, fruit juices and medicines).
	S.B.194	Requires a minimum 5¢ deposit on liquor and beverage containers, except milk and fruit juices.
Pennsylvania	H.B.304	Prohibits packaging, bottling or sale of beer or soft drinks in nonreturnable glass containers.
	H.B.595	Levies a 1¢ tax on manufacturers for nonreturnable containers that cannot be 99% destroyed by fire.
	S.B.4	Prohibits the packaging, bottling, sale, or use of any nonreturnable beer or soft drink glass containers.
	S.B.276	Requires malt or brewed beverages in cans have protective coverings on the can tops.
	S.B.402	Prohibits no-deposit glass beverage containers.
	S.B.405	Levies a 1¢ tax on each 7 oz. of beer and soft drinks in nonreturnable containers.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Pennsylvania (cont.)	S.B.823	Prohibits the sale of soft drinks and beer in nonreturnable containers.
	S.Res.25	Creates a 5-member Senate Bipartisan Committee to study the nonreturnable container problem.
Puerto Rico	H.B.1143	Permits shipment of malt beverages into Puerto Rico in containers of 1000 gal. or more.
	S.B.868	Same as H.B.1143.
Rhode Island	H.B.1013	Creates a special legislative commission to study establishing a uniform container for packing foodstuffs and beverages.
	H.B.1061	Requires 10¢ minimum deposit on all beer and carbonated beverage glass or metal containers.
	H.B.1236	Provides for a five-mill tax on nonreturnable bottles sold or held for sale.
	H.B.1673	Levies a 2¢ tax on nonreturnable liquid beverage containers.
	H.B.2451	Prohibits the sale of all beverages in nonretrunable bottles or containers.
	S.B.174	Prohibits the use of nonreturnable glass or metal beer and carbonated beverage containers.
	S.Res.556	Creates a special legislative commission to make findings and recommendations on nonreturnable containers of all types.
	S.Res.648	Creates a special legislative committee to study recycling glass and metal containers and their effect on the environment.
South Dakota	S.B.193	Prohibits the sale, manufacture, or delivery of nonreturnable glass, plastic, or metal beverage containers which have no money deposit. Bans cans with pull-top tabs.
Tennessee	H.B.969	Levies a 1¢ tax on the sale of nonreturnable soft drink and alcohol containers.
	S.B.845	Same as H.B.969.
Texas	H.B.81	Imposes a 2¢ tax on nonreturnable beer and soft drink containers.
	H.B.94	Prohibits the sale of any beverage in a disposable nonreturnable glass container, except milk, fruit juices, wine, liquor, or biodegradable glass containers.
	H.B.813	Requires those sellers of nonreturnable containers to pay refunds for the return of nonreturnable beverage containers.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Utah	H.B.281	Requires 3¢ deposit on glass soft drink containers, and 5¢ deposit on glass containers of alcohol.
Vermont	H.B.100	Requires a 5¢ deposit on beer and soft drink containers.
	J.Res.H.10	Provides for a committee of 9 to study methods of improving solid waste disposal.
	S.B.7	Prohibits the sale or dispensing of any beverage in a glass or metal container from a vending machine.
Washington	H.B.136	Makes the conversion or taking of returnable wholesale containers for agriculture commodities a misdemeanor.
	H.B.256	Levies an annual tax of .015% of the gross sales value of beer and of other products.
	H.B.281	Exempts deposits on food and beverage containers from the retail sales tax and business and occupation tax.
	H.B.699	Requires a minimum 5¢ deposit for beer and soft drink containers.
	S.B.87	Same as H.B.281.
	S.B.297	Same as H.B.256.
	S.B.428	Requires a gross sales tax of .015% on all levels of sales of beer and soft drinks and their containers and other products.
	S.B.513	Same as H.B.699.
	S.B.876	Provides for a Model Litter Control Act to alleviate the accumulation of litter.
West Virginia	H.B.523	Prohibits the sale or distribution of beer of 3.2% or less alcoholic content and soft drinks in nonreturnable glass containers.
	H.B.880	Prohibits the sale or distribution of soft drinks and nonintoxicating beer in nonreturnable containers.
Wisconsin	A.B.11	Requires statement on beverage containers of a minimum 5¢ refund for each container.
	A.B.255	Prohibits the sale of beer or soft drinks in nonreturnable bottles.
	S.B.162	Requires a minimum 3¢ deposit on all beer and soft drink bottles.
	S.B.440	Levies a 2¢ tax on nonreturnable containers not prohibited from being reused by Federal laws.
LOCAL ORDINANCES		
Alabama, Satsuma	Ordinance	Tax of 1¢ on nonreturnable containers.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Arizona,		
Scottsdale	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Tucson	Ordinance	Prohibits nonreturnable beer and soft drink containers.
California,		
Alameda Co. Garden Grove Modesto Novato Redlands Ventura	Resolution	Urges the legislature to adopt and enact legislation taxing nonreturnable containers of beer, soft drinks, and alcoholic beverages.
Azusa Belmont	Resolution	Urges legislature to enact statewide mandatory deposit on nonreturnable and nonbiodegradable containers.
Claremont	Ordinance	Concerns recycling.
Glendora	Ordinance	Prohibits nonreturnable containers.
Livermore	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Pasadena	Resolution	Requests industry to investigate recycling and antilitter programs.
Riverside	Ordinance	Prohibits nonreturnable beer and soft drink containers.
San Anselmo	City Council	Appointed committee on ecology.
San Bernardino	Ordinance	Prohibits nonreturnable beer and soft drink containers.
San Francisco	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers.
Santa Barbara	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers.
South Pasadena	Ordinance	Requires retailers to market beverages in returnable containers substantially matching those sold in nonreturnable containers.
South San Francisco	Ordinance	Bans nonreturnable metal and glass containers in which beer and soft drinks are sold.
Colorado,		
Boulder	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Delaware,		
Elsmere	Ordinance	Prohibits nonreturnable beer and soft drink containers.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Florida,		
Sarasota	Ordinance	Prohibits nonreturnable beer containers of metal or glass.
Illinois,		
Chicago	Ordinance	Prohibits nonreturnable beverage bottles.
Highland Park	Ordinance	Prohibits nonreturnable containers.
Urbana	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Woodstock	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Indiana,		
Elkhart	Ordinance	Prohibits nonreturnable beverage containers.
South Bend	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Iowa,		
Des Moines	Ordinance	Prohibits nonreturnable beverage containers.
Iowa City	Ordinance	Prohibits nonreturnable soft drink and beer containers.
Kansas,		
Manhattan	Ordinance	Prohibits nonreturnable beer and soft drink containers of glass or metal.
Maryland,		
Baltimore	Bill 1379	Taxes nonreturnable beverage containers of 1¢ to 2¢.
Bowie	Ordinance	Requires a minimum 5¢ deposit on all beer and soft drink containers of glass, metal and plastic.
Howard Co.	Ordinance	Prohibits nonreturnable beer and soft drink containers without a 5¢ minimum deposit.
Prince George and Montgomery Counties	Ordinance	Prohibits the possession or sale of nonreturnable beverage containers on park property in the counties.
Rockville	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Massachusetts,		
Andover	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Bedford	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Fitchburg	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Marlboro	Ordinance	Prohibits beverages sold in nonreturnable glass bottles.
Michigan,		
Dearborn	Ordinance	Prohibits nonreturnable containers.
Detroit	Ordinance	Requires a 5¢ deposit on containers of beer, soft drinks, and fruit drinks.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Michigan (cont.), Ingham Co.	Ordinance	Prohibits nonreturnable containers.
Kalamazoo Co.	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Lake Co.	Ordinance	Prohibits the sale of nonreturnable beverage containers.
Livonia	Ordinance	Prohibits the sale of nonreturnable beverage bottles.
Oakland Co.	Ordinance	Prohibits nonreturnable containers.
Southgate	Ordinance	Prohibits nonreturnable bottle, can, and paper cup containers.
Sterling Heights	Ordinance	Prohibits the sale of carbonated and alcoholic beverages in nonreturnable glass and metal containers.
Troy	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable glass containers.
Wayne City	Ordinance	Prohibits nonreturnable beer and soft drink glass bottles.
Minnesota, Bloomington	Ordinance	Prohibits nonreturnable beverage containers.
Crystal	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers.
Deephaven	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers.
East Bethel	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers.
Minneapolis	Ordinances	Prohibit nonreturnable cans and bottles, and require 1¢ to 3¢ deposit on beverage containers.
Princeton	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers.
St. Louis Park	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers.
Missouri, Creve Coeur	Bill 568	Prohibits nonreturnable glass beverage containers.
Florissant	Bill 2650	Prohibits nonreturnable beer and soft drink containers.
St. Charles	Ordinance	Prohibits the sale of beer and soft drinks in 12 oz. and 16 oz. cans and nonreturnable bottles of 48 oz. or less.
St. Louis	Bill 24	Requires retailers of beer, soda, and other beverages to charge a minimum 5¢ deposit on cans and nonreturnable bottles.
Montana, Missoula	Ordinance	Prohibits or taxes nonreturnable containers.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Montana, Missoula (cont.)	Ordinance	Requires a 5¢ deposit on beer and soft drink nonreturnable containers.
Nevada, Clark Co.	Ordinance	Levies 1¢ tax on each can or bottle of beer sold at wholesale.
New Jersey, Edgewater	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers.
Irvington	Ordinance	Prohibits the use of nonreturnable containers for all types of products.
Newark	Ordinance	Prohibits soft drink and beer nonreturnable containers.
Princeton	Ordinance	Prohibits nonreturnable beer and soft drink containers.
West Milford	Ordinance	Prohibits nonreturnable beer and soft drink containers.
New York, Buffalo	Ordinance	Taxes nonreturnable bottles.
Erie Co.	Ordinance	Prohibits the sale, distribution, or exchange of nonreturnable beer and soft drink containers.
New York City	Bill 64	Prohibits the sale or distribution of beverages in any glass bottle or jar, the mouth of which measures less than a 2 inch diameter.
	Bill 136	Prohibits the sale of beverages in containers without a 10¢ deposit for bottles and a 5¢ deposit for metal and plastic containers.
	Bill 341	Prohibits nonreturnable beverage containers.
North Carolina, Salisbury	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Ohio, Akron	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Barberton	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers of metal or glass.
Cincinnati	Ordinance	Prohibits beer and soft drink nonreturnable containers.
Worthington	Ordinance	Prohibits nonreturnable beer and soft drink containers.
Pennsylvania, Philadelphia	Resolution	Investigates the possible elimination or control of nonreturnable beverage containers.

Table A-2 (continued)

Legislative body	Bill	Characteristics
Rhode Island, Providence	Ordinance	Prohibits nonreturnable soft drink and beer containers.
Vermont, Northfield	Resolution	Prohibits the sale of beer and soft drinks in nonreturnable bottles.
Virginia, Loudoun Co.	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers.
Washington, Pullman	Ordinance	Requires a 5¢ minimum deposit on beer and soft drink containers.
Wisconsin, Madison	Ordinance	Requires the sale of beer and soft drinks in returnable as well as nonreturnable containers.
Milwaukee	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers unless also offered by the seller in reusable containers.
Richland Co.	Resolution 19	Prohibits retail sale of soft drinks and beer in nonreturnable bottles.
Wyoming, Casper	Ordinance	Prohibits the sale of beer and soft drinks in nonreturnable containers unless also offered for sale in returnable containers.

Appendix B: BEVERAGE CONSUMPTION AND CONTAINERIZATION TRENDS

B.1 Introduction

Beverage consumption and containerization trends were analyzed and projected in order to provide a basis for identifying probable future trends in the beverage container problem. Since beverage containerization is related to the consumption of beverages, the trends in beer and soft drink consumption were examined in some detail. Consumption was then converted to fillings and finally to the various types of containers.

Projections in beverage consumption and containerization were made for 1976, extrapolating data from 1955 to 1969. Consumption equations were estimated using income and the population age distribution as explanatory variables. Containerization was projected based on trends in container size and the proportions of the various types of containers.

B.2 Summary

To a large extent, the per capita growth for any one beverage must come at the expense of other beverages. The age composition of the population plays a significant role in determining the growth in the consumption of a beverage since tastes vary by age as shown below.[1]

	Beverages Preferred		
Age Group	First	Second	Third
Under 5 years	milk	soft drinks	fruit juice
5-19	soft drinks	milk	fruit juice
20-34	beer	soft drinks	coffee
35-64	liquors	coffee	soft drinks
65 and over	coffee	liquors	soft drinks

As developed below, per capita consumption of soft drinks and beer is expected to be 6,300 ounces annually by 1976, 26 percent above 1969's value. This projected growth is based on projections of economic and demographic trends and expectations of continued

Table B-1. SUMMARY OF BEVERAGE CONSUMPTION AND CONTAINERIZATION TRENDS

	1955	1969	1976
Soft Drinks			
Cases (billions)	1.2	2.9	4.2
Containerization (billions)			
Refillable bottles*	31.4	29.7	16.8
Nonrefillable bottles	0.2	6.4	12.9
Cans	0.3	11.8	26.3
Beer			
Barrels (millions)	85.5	114.9	145.5
Containerization (billions)			
Refillable bottles*	14.4	11.3	8.5
Nonrefillable bottles	1.2	6.8	11.7
Cans	7.4	16.7	24.8

Source: Historical data, Glass Containers Manufacturers Institute, Inc., Glass Containers, 1970; Can Manufacturers Institute, Inc., Annual Report: Metal Can Shipments, 1969; projections by Research Triangle Institute.

*Fillings.

intensive marketing efforts. Fillings (containerization) are expected to be about 101 billion, 75 percent of which will be in one-way containers as shown in Table B-1.

B.3 Soft Drink Consumption

B.3.1 General

Soft drink production has a long history reaching back to the introduction of carbonated water in England in the latter half of the 18th century. Today, soft drinks are ubiquitous due to vigorous marketing efforts by soft drink manufacturers, distributors, and retailers coupled with consumer acceptance brought about by changes in income, taste, the increase in leisure time, and favorable demographic factors. Soft drink manufacturers employ about 129,000 workers producing beverages valued at over $4 billion.[2] In 1970 the average person consumed almost 8 ounces of soft drinks daily, roughly 16 percent of his total daily consumption of liquids.

Soft drink consumption is expected to increase 5.8 percent annually through 1976, because of anticipated favorable trends in income and population factors. This rate is below the 6.1 percent annual rate for the period 1955-69.

B.3.2 Consumptions Trends

As Figure B-1 shows, soft drink consumption and production (the terms are used synonymously here) has increased steadily over the last 14 years, increasing from 1.3 in 1955 to 2.9 billion cases in 1969. The average annual rate of growth in the period was 6.1 percent; however, it has varied on a year-to-year basis.

Assuming the continued historical relationship between per capita income and per capita consumption and expenditures for soft

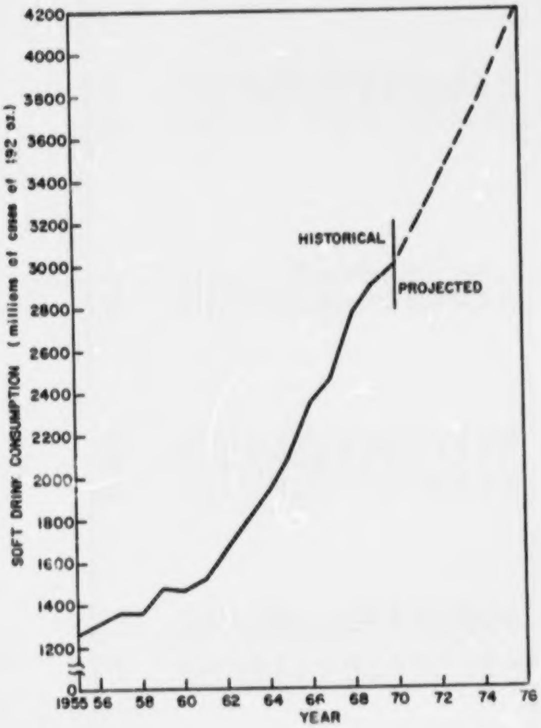

Figure B-1. Soft drink consumption (Historical data from National Soft Drink Association; projections by Research Triangle Institute).

Table B-2. PROJECTIONS OF SOFT DRINK CONSUMPTION

Year	Total population (thousands)	Population ages 10-29 (thousands)	Population ages 10-29 (% of total)	Personal income per capita (1967 $)	Soft drink consumption (thousands of 192-oz. cases)	Soft drink value of production (thousands of 1967 $)	Soft drink consumption per capita (oz.)
1955	165,931	47,226	28.5	$2,310	1,264,925	$1,900,267	1,464
1956	168,903	47,597	28.2	2,378	1,321,214	1,966,917	1,502
1957	171,984	48,968	28.5	2,390	1,360,850	1,935,693	1,519
1958	174,882	50,075	28.6	2,263	1,359,489	1,982,589	1,493
1959	177,830	51,255	28.8	2,437	1,484,560	2,143,066	1,603
1960	180,684	52,426	29.0	2,468	1,476,544	2,179,751	1,569
1961	183,756	53,858	29.3	2,498	1,524,236	2,269,334	1,593
1962	186,656	55,426	29.7	2,586	1,667,514	2,452,227	1,715
1963	189,417	57,193	30.2	2,651	1,800,915	2,719,151	1,826
1964	192,120	59,079	30.8	2,749	1,948,590	2,805,279	1,947
1965	194,592	60,999	31.3	2,888	2,104,282	2,996,240	2,076
1966	196,920	63,009	32.0	3,058	2,352,587	3,371,529	2,294
1967	199,118	65,068	32.7	3,161	2,470,452	3,458,632	2,382
1968	201,166	67,075	33.3	3,309	2,777,035	3,885,776	2,651
1969	203,216	68,933	33.9	3,419	2,913,110	3,877,253	2,752
projected 1976	220,315	78,999	35.9	$4,196	4,218,114	$5,662,096	3,676

Sources:

Historical Data
Population--Bureau of Census, U.S. Department of Commerce.
Personal income--Office of Business Economics, U.S. Department of Commerce.
Soft drink consumption and production--National Soft Drink Association.

Projections
Population--Bureau of Census, U.S. Department of Commerce.
Personal income--Office of Business Economics, U.S. Department of Commerce, interpolation between 1980 projection and 1970 value.
Soft drink consumption and value of production--Research Triangle Institute.

drinks, we project 1976 consumption levels to be 36 percent above that for 1970.* Per capita consumption is expected to increase at 4.5 percent annually over the next five years, somewhat above the anticipated growth in per capita income. By 1976 per capita consumption is projected to reach 3,676 ounces annually (see Table B-2) or ten ounces per day. With the expected increase in population, total consumption should increase at an average rate of 5.8 percent.

The growth in soft drink consumption has primarily been due to favorable economic and demographic trends and to an aggressive marketing effort on the part of manufacturers, distributors, and retailers. Figure B-2 shows the key economic and demographic variables which contributed to the increase in soft drink consumption.

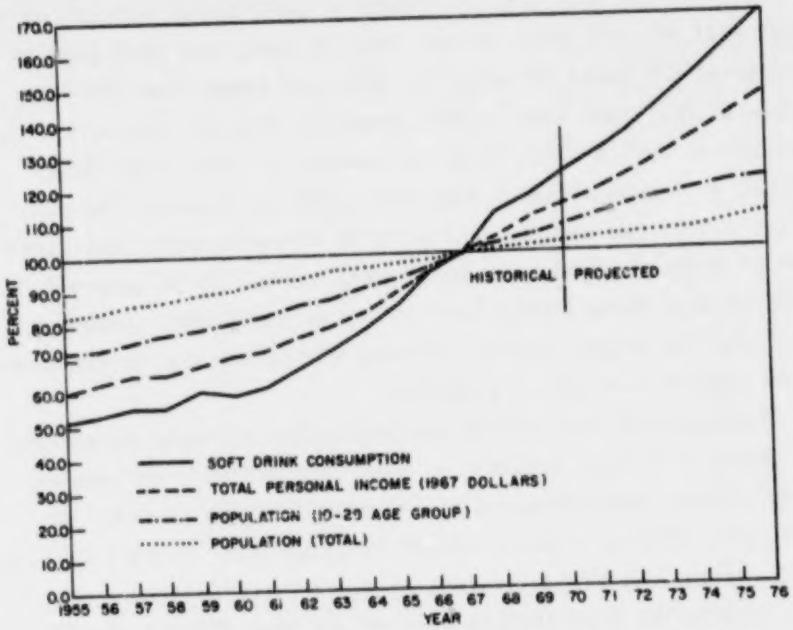

Figure B-2. Growth of soft drink consumption, population, and income (Research Triangle Institute).

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* It is not anticipated that per capita income will be a good explainer toward the end of the seventies due to the projected divergence in per capita income and the share of the population in the 10-29 age group after 1976. Prior to this time, the two indicators have been moving together.

Since 1955 personal income has increased at an average annual rate of 4.3 percent (in constant dollars). On an average per capita basis, personal income increased from $2,310 in 1955 to $3,419 in 1969 (1967 dollars) or at an average annual rate of 2.8 percent. Not only have consumers had more income to spend on soft drinks, but 22 million additional people have joined the 10-29 age group since 1955 increasing its share of total population from 28.5 to 33.9 percent (see Figure B-2 for these trends).

On the marketing front, there has been the introduction of new flavors and changes in the packaging and distribution system emphasizing consumer convenience. These efforts have been brought to the consumer's attention through intensive advertising.

Cola is the most popular flavor of soft drink, accounting for about half of soft drink sales. Next to cola, the most popular flavors on the basis of sales in 1970 were lemon-lime (14.4%), orange (7.8%), root beer (6.3%), grape (3.8%), and ginger ale (2.7%).[3] Low-calorie soft drinks, first introduced in 1950, have shown impressive growth although they have suffered somewhat recently due to the ban on cyclamates. While there is undoubtedly some substitution of dietetic drinks for other soft drinks, it is generally believed that these drinks have attracted additional consumers interested in weight control, thereby giving impetus to the growth in per capita beverage consumption.

Packaging of soft drinks has emphasized consumer convenience and choice with such features as easy-open closures and one-way, nonrefillable containers and with a proliferation of sizes of containers ranging from 6.5 ounces to 24 ounces. Plastic bottles are a future possibility because of their light weight.

Systems for distributing soft drinks have changed significantly with at-home consumption today accounting for over two-thirds of total consumption, about the same share that on-premise consumption had at the beginning of this century.[4] However, the reason that on-premise consumption has been able to retain even one-third of consumption is due to rapid growth in vending machines, for fountain

Table B-3. DISTRIBUTION OF SOFT DRINKS 1970
(percentage shares)

Food chains, supermarkets		31
Independent food stores		24
Subtotal	55	
Service stations		10
Beverage distributors		9
Bars, taverns		8
Cash and carry		6
Recreational outlets		5
Discount stores		4
Other		3

Source: "How Business?" 1970--14th Annual Softdrinks sales survey, p.3.

and package shares have dropped significantly throughout this century. Today, 20 percent of sales are from vending machines.

Most soft drink distribution is through food chains and independent food stores as shown in Table B-3. Recently, however, cash and carry stores and discount stores have all increased their shares.

As a result of these favorable economic and demographic developments plus changes in packaging and marketing, there has been an increase in the per capita consumption of soft drinks. As Figure B-3 shows, had per capita soft drink consumption remained at the 1955 level, 1969 production would have increased by only 284 million cases. The increase in per capita consumption, however, has provided the most important source of growth, contributing an additional 1,364 million cases--4.8 times the population contribution. Figure B-4 shows actual average per capita consumption for the entire population and also for the 10-29 age group assuming they consumed all soft drinks.

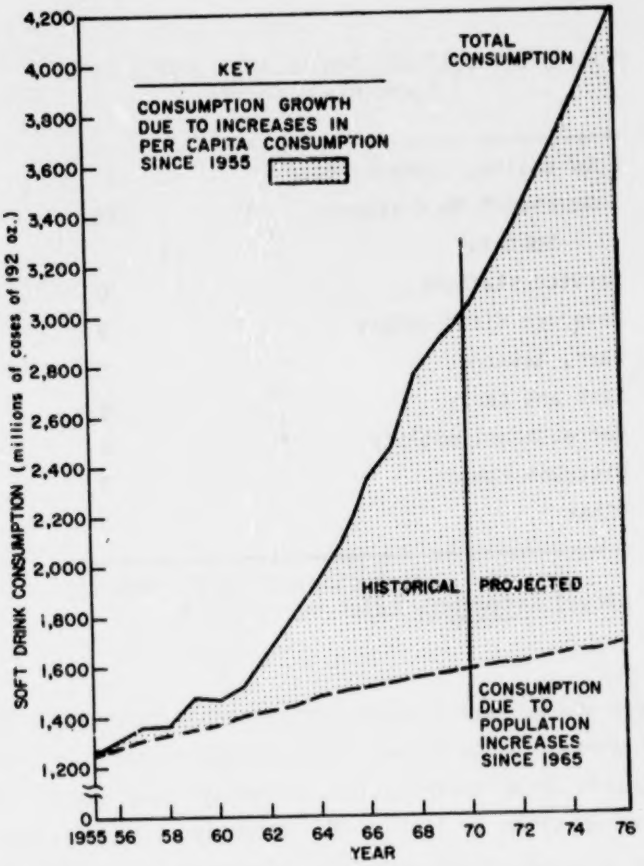

Figure B-3. Sources of soft drink consumption growth (Research Triangle Institute).

B.3.3 Soft Drink Containerization

In 1969 there were over 47 billion soft drink fillings of which about 60 percent were in refillable containers. Refillable bottles have shown virtually no growth during the last 15 years causing their share of soft drink containerization to decline from 99 percent in 1955 to their current level. By 1976, the nonrefillable bottles are projected to have about 70 percent of the market share.

Consumer preference for convenience packaging, shifts in the distribution of soft drinks toward off-premise and vending machine

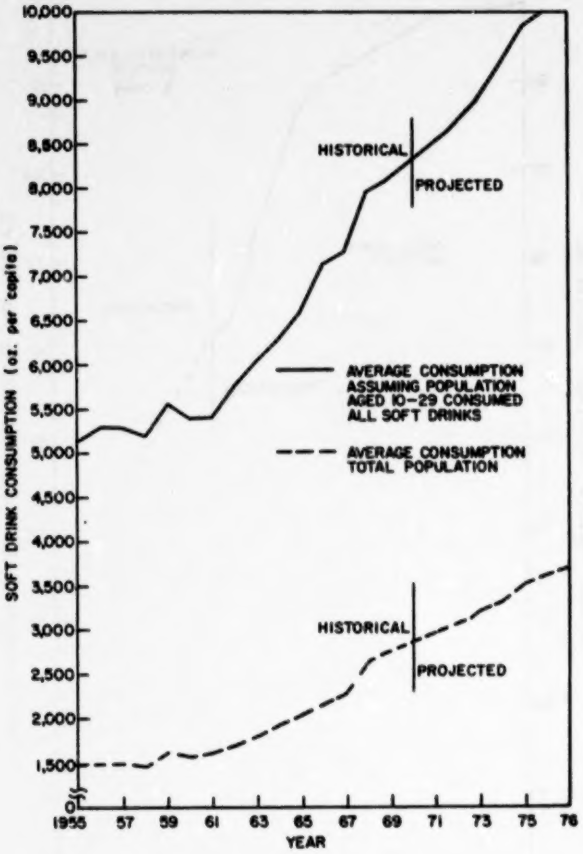

Figure B-4. Average soft drink consumption per capita (Research Triangle Institute).

sales, and the push by the glass industry to nonrefillable bottles as a means of selling more glass have all contributed to the growing share of nonrefillables.

Figure B-5 shows the trend in soft drink fillings between refillable bottles and nonrefillable containers and the projected shares.

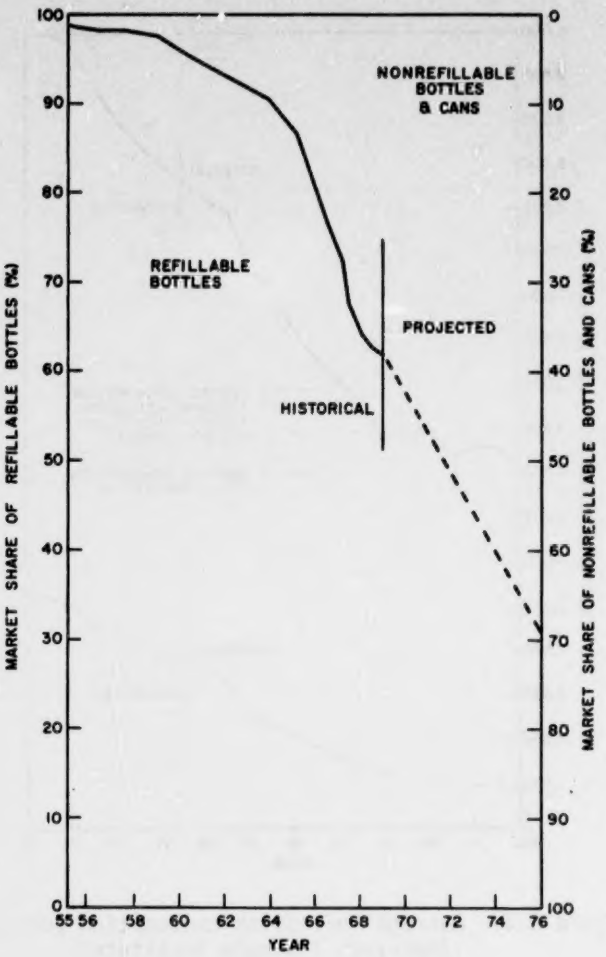

Figure B-5. Market shares: soft drink containerization (Research Triangle Institute).

As shown in Figure B-6 and Table B-4, approximately 56 billion soft drink fillings are projected for 1976. About 39 billion are projected to be in nonrefillable bottles and cans, the remaining 17 billion in refillable bottles.

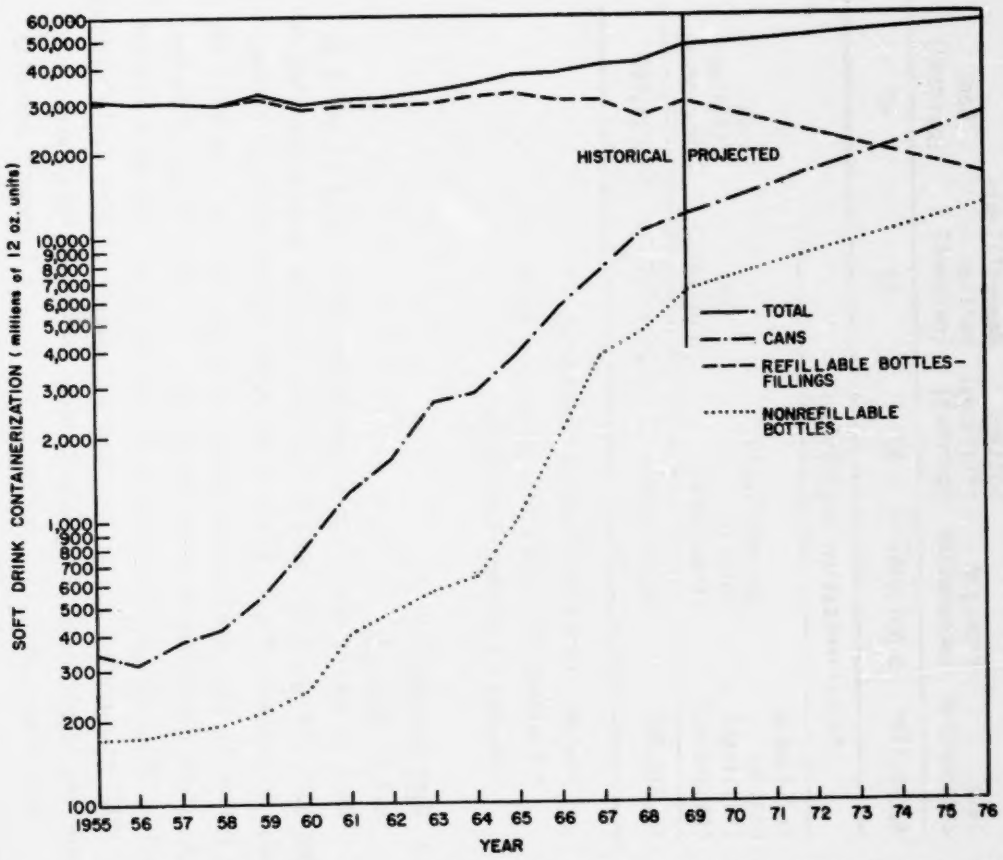

Figure B-6. Soft drink containerization trends (packaged). (Historical data, National Soft Drink Association, projections by Research Triangle Institute).

Table B-4. SOFT DRINK CONTAINERIZATION PROJECTIONS, 1976

		Market shares		
Total consumption	Packaged consumption	Refillable bottles (fillings) (percent)	Nonrefillable bottles (percent)	Cans (percent)
4,218,114*	3,501,035†	30	23	47

Containerization projections			
Refillable bottles (fillings) (thousands)	Nonrefillable bottles (thousands)	Cans (thousands)	Total fillings (thousands)
16,804,968	12,883,809	26,327,783	56,016,560

Source: Research Triangle Institute.

*Thousands of cases, 192 ounces per case.

†Assumes 20 percent bulk sales.

B.4 Beer Consumption

B.4.1 General

Beer is one of man's oldest beverages dating back at least to 6000 B.C. Today, lager beer is the most popular type accounting for about 95 percent of U.S. sales. The remainder of the U.S. market is shared by ale, porter, and stout varieties of ale. One-half the U.S. adult population are beer drinkers. The malt liquor industry employs about 60,000 employees with 1969 sales of over $3.4 billion.[5] In 1970, the average person consumed 6.7 ounces of beer daily although there are significant variations between urban and rural areas.

Beer consumption is expected to increase 3.4 percent annually through 1976, significantly above the average rate of 2.6 percent annually between 1955 and 1970.

B.4.2 Consumption Trends

Beer consumption has increased in an erratic fashion during the last 15 years with several years registering negative growth in beer consumption--see Figure B-7. The rate of growth in beer consumption, however, has trended upward.

Based on the anticipated growth in both personal income and the adult population, especially the group aged 20-34, 1976 consumption is expected to reach 145 million 31-gallon barrels, 16 percent above the 1970 level. As shown in Table B-5, we project per capita beer consumption to reach 2,620 ounces annually in 1976, an annual growth rate of 2.2 percent.

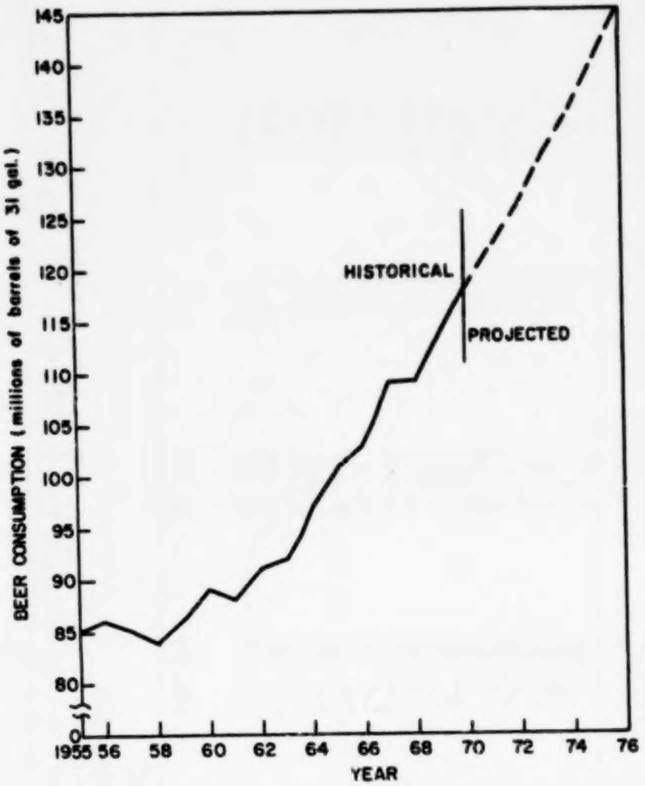

Figure B-7. Beer consumption (Historical data, U.S. Brewers Association; projections by Research Triangle Institute).

Table B-5. PROJECTIONS OF BEER CONSUMPTION

Year	Total population (thousands)	Population ages 20-34 (thousands)	Population ages 20-34 (% of total)	Personal income per capita (1967 $)	Beer consumption (thousands of 31-gallon barrels-removals)	Beer value of production (thousands of 1967 $)	Beer consumption per capita (oz.)
1955	165,931	34,997	21.1	$2,310	85,460	$2,191,400	2,044
1956	168,903	34,738	20.6	2,378	86,382	2,234,700	2,029
1957	171,984	34,447	20.0	2,390	85,140	2,244,206	1,964
1958	174,882	34,294	19.6	2,363	84,791	2,164,500	1,924
1959	177,830	34,138	19.2	2,437	86,387	2,270,200	1,928
1960	180,684	34,027	18.8	2,468	89,651	2,328,500	1,969
1961	183,756	34,066	18.5	2,498	88,693	2,345,400	1,915
1962	186,656	34,327	18.4	2,586	91,523	2,419,900	1,946
1963	189,417	34,959	18.5	2,651	92,290	2,434,400	1,933
1964	192,120	35,471	18.5	2,749	97,090	2,575,400	2,005
1965	194,592	36,048	18.5	2,888	101,244	2,579,800	2,065
1966	196,920	36,669	18.6	3,058	103,213	2,746,600	2,080
1967	199,118	38,264	19.2	3,161	109,283	2,954,300	2,178
1968	201,166	39,696	19.7	3,309	109,904	3,074,400	2,168
1969	203,216	41,165	20.3	3,419	114,925	3,243,400	2,244
projected 1976	220,315	52,150	23.7	$4,196	145,470	$4,324,800	2,620

Sources:

Historical Data
Population--Bureau of Census, U.S. Department of Commerce.
Personal income--Office of Business Economics, U.S. Department of Commerce.
Beer consumption and production--U.S. Treasury Department, U.S. Department of Commerce.

Projections
Population--Bureau of Census, U.S. Department of Commerce.
Personal income--Office of Business Economics, U.S. Department of Commerce, interpolation between 1980 projection and 1970 value.
Beer consumption and value of production--Research Triangle Institute.

The primary source of the fluctuations in beer consumption in the late 1950's and early 1960's was the decline in the 20-34 age group, both absolutely between 1955 and 1960 and as a percent of the total population from 1955 and 1962. The 20-34 age group is a critical influence on consumption trends, as about 80 percent of the males and 45 percent of the females in this age group are beer consumers.[6] As Figure B-8 shows, it wasn't until 1963 that the population aged 20-34 reached its 1955 level. It wasn't until 1971 that it comprised the same percentage (21 percent) of total population as it represented in 1955.

The growth in beer consumption as shown in Figure B-9 has not been as dependent on increases in the average per capita consumption as was soft drink consumption. For several years, per capita consumption actually declined. With the continuation of current trends, we are projecting only moderate consumption increases on a per capita basis, see Figure B-10.

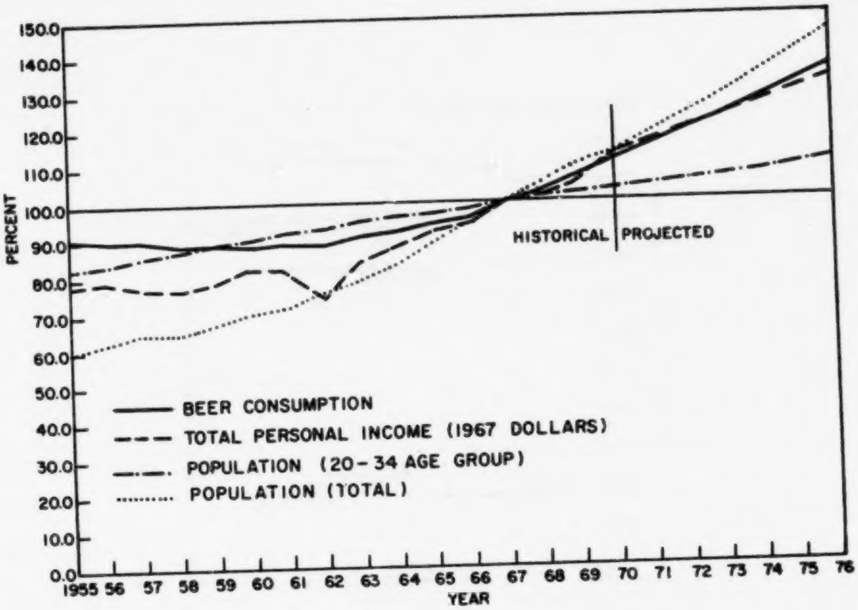

Figure B-8. Growth of beer consumption, population, and income (Research Triangle Institute).

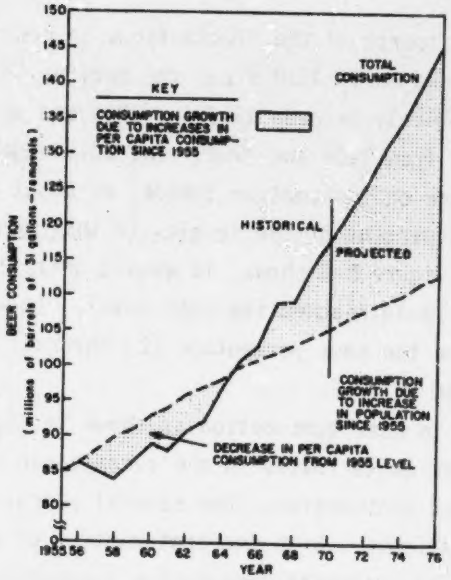

Figure B-9. Sources of beer consumption growth
(Research Triangle Institute).

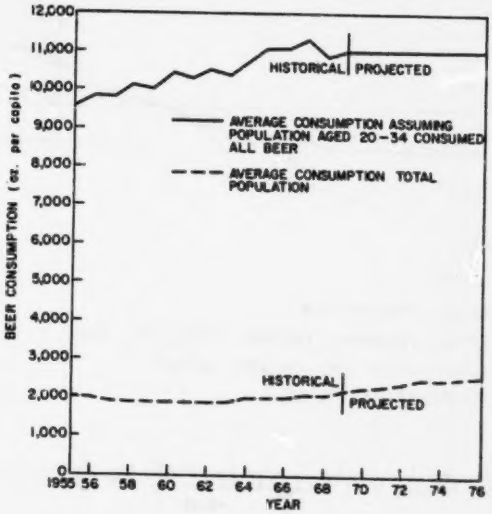

Figure B-10. Average beer consumption per capita
(Research Triangle Institute).

Although beer consumption is influenced by the level of personal income, the distribution of that income is critical; for while beer consumption increases moderately with family income up to $10,000 annually, beyond $10,000 consumers tend to substitute distilled spirits for beer. Ethnic backgrounds and climate are also important. The consumption of beer also has a strong seasonal component with summer consumption, roughly 50 percent greater than winter consumption.

Since most beer cannot be stored for more than one month because of quality deterioration, industry productive capacity is geared to meet the peak demand occurring in the summer months. As a result, production averages about 85 percent of capacity on an annual basis. The preference of brewers for carrying excess capacity in capital rather than labor tends to increase the size of breweries. Brewery size has also increased to achieve greater production economies of scale and reach a larger market so that regional fluctuations in the demand can be more easily smoothed out. As a result of these pressures, since 1934 the number of breweries has dropped from 714 to 154. This trend toward fewer breweries was encouraged and permitted by the introduction of nonrefillable containers. These containers can be economically shipped longer distances than refillables.

B.5 Beer Containerization

Nonrefillables, especially cans, dominate the beer packaging market which reached over 34 billion fillings in 1969.

The trends toward nonrefillable containers began earlier for beer containerization than for soft drinks containerization. For example, in 1955, cans had 32 percent of the packaged beer market, a figure not expected to be reached until 1972 in the soft drink industry.

Our projection of the trend in beer containerization indicates that by 1976 over 80 percent of the packaged beer will be in nonrefillable containers (see Figure B-11). The primary market for refillables will continue to be taverns and restaurants.

As shown in Figure B-12 and Table B-6, 45 billion beer fillings are projected for 1976. Over 36 billion nonrefillable cans and bottles are projected.

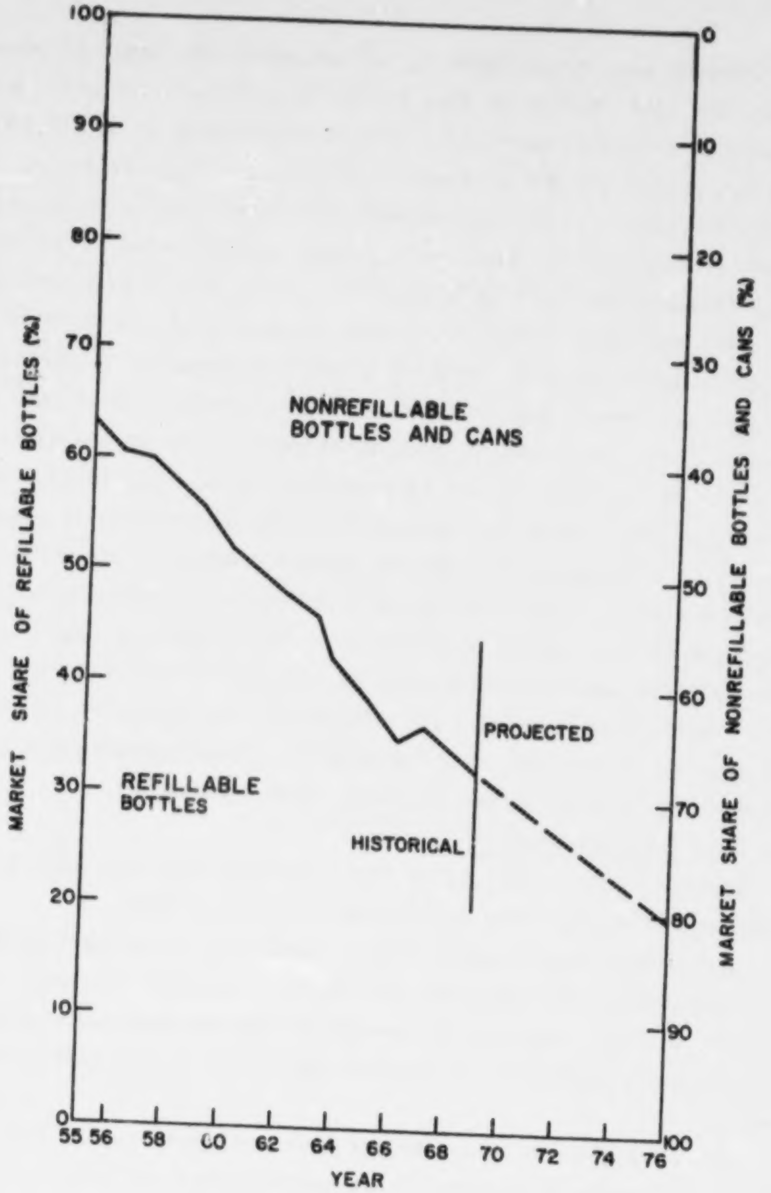

Figure B-11. Market shares: beer containerization (Research Triangle Institute).

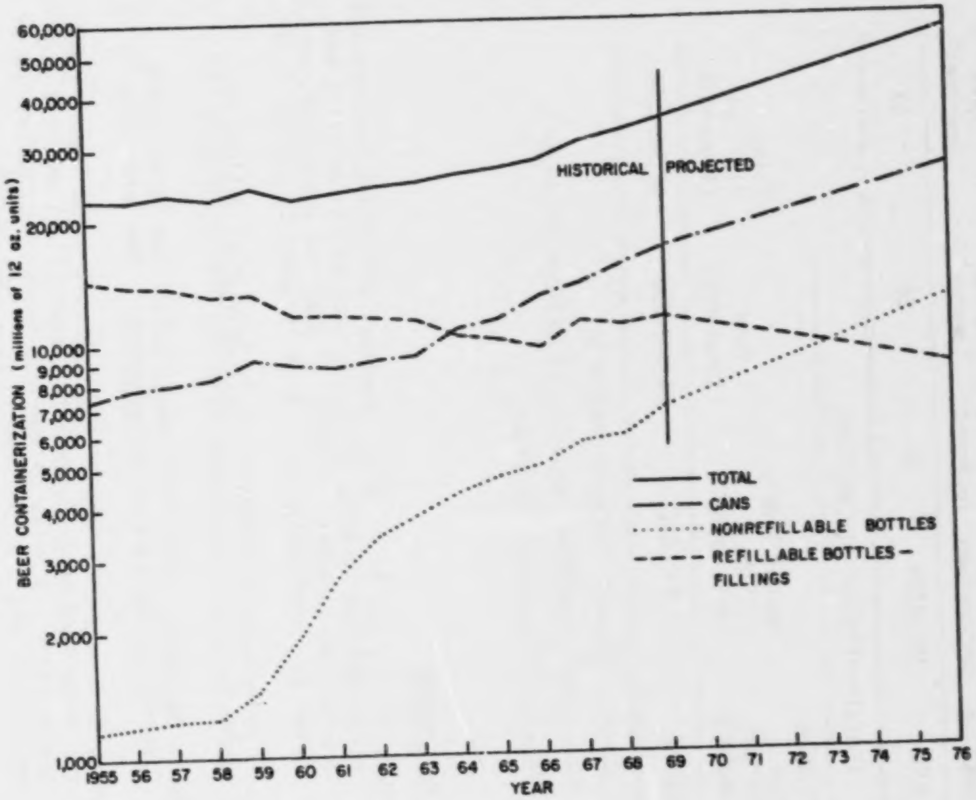

Figure B-12. Beer containerization trends (packaged). (Historical data, U.S. Brewers Association; projections by Research Triangle Institute).

Table B-6. BEER CONTAINERIZATION, 1976

Total consumption	Packaged consumption	Market shares: Refillable bottles (fillings) (percent)	Nonrefillable bottles (percent)	Cans (percent)
145,470*	125,470†	19	26	55

Containerization projections: Refillable bottles (fillings) (thousands)	Nonrefillable bottles (thousands)	Cans (thousands)	Total fillings (thousands)
8,582,148	11,743,992	24,843,060	45,169,200

Source: Research Triangle Institute.

*Thousands of barrels removals, 31 gallons per barrel.

†Assumes 17 percent bulk sales.

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Appendix C: TECHNOLOGY TRENDS IN BEVERAGE CONTAINERS AND RECYCLING

C.1 Introduction

There is keen competition between the glass, aluminum, and steel industries for the beverage container market. Such competition is heavily dependent on the relative prices of the materials which, in turn, are determined by the costs of extracting the raw materials, converting them into purified or concentrated forms, and delivering the plate, sheet, or shape to the manufacturer of the container.

Before World War II, glass dominated beverage containerization. Since then, technological progress has introduced different materials to the market for beverage containers. Substantial improvements in steel and aluminum fabrication has led to the large-scale acceptance of metal cans first by beer producers and distributors and later by the soft drink industry.

This appendix outlines the major technological trends in beverage containers and the processes and problems involved in recycling of beverage containers.

C.2 Major Trends in Containerization

C.2.1 Glass Bottles

The most significant trend in glass beverage containerization has been the displacement of refillable by nonrefillable containers for both beer and soft drinks. This has been made possible in part by weight reductions and strength increases that permit a cheaper product that can still withstand the pressure of the liquid. There is less glass per unit, lower raw material costs per unit, less weight per unit, and, therefore, lower transportation costs. During the last 20 years, the weight of most glass containers has been reduced by about one-third.[1] In 1970, nonrefillable bottles cost the bottler about half the price of refillable bottles; see Table C-1. However, they are more expensive on a per filling basis since each refillable bottle is used several times. The most favorable comparison shows nonrefillable bottles costing 13 times as much per filling as the refillables on the basis of 16 trips per refillable bottle.

Table C-1. COST OF GLASS BEVERAGE CONTAINERS TO THE BOTTLER, 1970

Container type	Unit cost to bottler	Average number of trips	Cost per trip to bottler
Refillable bottle	.08	16-30	.0027-.005
Nonrefillable bottle	.035-.045	1	.035-.045

Source: U.S. Department of Commerce. Industrial Outlook, 1970. Washington, U.S. Government Printing Office, 1970.

The most radical new development in glass beverage containers is a bulb-shaped, nonrefillable glass bottle set permanently in a polyethylene base, which can be partially separated from the glass after crushing by flotation. This new bottle will weigh less than half the present weight of nonrefillable bottles, will be stronger, and will be produced 3 times faster (600 bottles per minute) than conventional nonrefillable bottles.[2]

Another development for nonrefillable bottles is a shrink-on plastic band around the bottom half of the bottle. This band will permit the bottles to be grouped in six-packs by a simple neck binding much the way cans are. The plastic serves as a buffer that reduces the need for additional packaging.

Several other important technological changes are expected in the beverage container industry: (a) New closures are being developed. (b) Shatterproof bottles will probably be available in the next 5 years. (c) Decorations can now be put on bottles faster. (d) Filling rates of 2,000 bottles per minute are anticipated, 3 times faster than present rates. (e) It is now possible to color glass for smaller production runs. (f) A glass container is being studied that can be processed to dissolve in water after use; the container would be a water soluble superstructure (e.g., sodium silicate) with a thin impervious film barrier.[3]

C.2.2 Metal Cans

Perhaps the most important development in the metal can industry is the increased use of aluminum cans. Since their introduction in 1960, shipments had grown from 23,000 tons to 337,000 tons by 1969.[4] Large quantities of aluminum are also used for easy-open ends on steel beverage cans. Most aluminum cans are currently used for beer and soft drinks. Aluminum's share of both markets is growing rapidly.

There have been advances in the "tin can" or, more accurately, the steel can portion of the metal can industry. Double-reduced "thin" tinplate permits more cans per pound of steel thereby reducing per unit materials requirements. Aluminum cans are also thinner than when first introduced. An innovation of significance for recycling is tin-free steel (TFS). Tin was originally used for the interior coatings and to aid in the solderability of the side seam. For some time now, organic coatings could have replaced the tin coating had the tin not been necessary for soldering. However, the recent development of organic cement and resistance welding have eliminated the need for tin coating.[5] Other improvements in can manufacturing technology include improved printing and lining techniques.

C.2.3 Plastic Containers

Plastic has several potential advantages as a beverage container. It is lightweight, transparent, and shatter-resistant, and it may be molded into many different shapes and colors. Offsetting these advantages are the present high cost of the resin, gas permeability problems, and poor compatibility of most plastics resin with certain beverages. These last two factors limit the shelf life of soft drinks to about 6-8 weeks in plastic containers compared to 6-8 months in glass and metal containers.

Most of the plastic bottles being proposed for soft drinks are either made of acrylonitrile resins (Barex 210 or Lopac). Bottles of either material are about 17 percent lighter than those made of polyvinyl chloride (PVC). The new plastics are much less gas permeable than PVC, they add no taste or odor to the contents, they break less easily than glass, and only weigh 20 percent as much.

The expected future cost per container with large-scale production is $0.03 about the same as that for glass but less than that for metal cans. Barex and Lopac bottles would only be used for soft drinks since beer requires pasteurizing at 140° to 150°F.[6] Both can apparently be burned without emitting annoying or noxious gases. The composition of incinerator effluents did not change when Barex resin was added at levels from 0.5 to 8 percent of typical waste materials.[7]

Two soft drink companies are now test marketing a 10-ounce plastic container. The liquor industry is already using PVC half-gallon containers because of weight advantages. (A glass half-gallon liquor bottle averages 2-1/2 pounds; a plastic one weighs 3-1/2 ounces.) Plastic half-gallon containers are still only a small portion of all half-gallon units, but by 1980 some observers expect that virtually all containers of this size may be plastic.

C.3 Technology of Recycling

Recycling differs from reuse in that the latter simply requires cleaning the container after the beverage has been consumed. Beer and soft drink bottles have traditionally been reused or refilled. Recycling means the container is broken and melted before it is made into a new container. For example, glass bottles are broken, melted, and molded before they are used again, and metal cans are shredded, melted, rolled, and formed before reuse.

C.3.1 Glass Bottles

Glass is made of sand (72%), soda ash (12%), and limestone (13%), plus feldspar and small quantities of other materials. The raw material costs of glass are low because the major ingredients are abundant in the earth's crust. There is still, however, an incentive to recycle glass because the addition of waste glass, called cullet, reduces the melting temperature in the furnace, lowers the fuel requirements, extends the life of furnace linings, and produces a "melt" faster than is possible with only virgin materials.[8] Cullet is so useful that if none is available from rejects or trim waste, the factory will intentionally produce it.

Cullet must be sorted by color and be free of metal and other impurities. Because of variances in the chemical composition of purchased cullet, manufacturers prefer cullet generated internally. The percentage of cullet used in all glass products varies from 8 to 100 percent of the weight of the inputs. The glass container industry has a goal of 30 percent purchased cullet[8] but there are apparently no physical limitations to using cullet exclusively. A market probably exists for all the cullet that can be produced, if it is of sufficiently high quality and sufficiently low price.

Most members of the Glass Containers Manufacturers Institute will pay $20 per ton for clean, cap-free, color-sorted cullet delivered to the plant.[8] However, glass cannot usually be collected, separated, crushed, cleaned, and delivered profitably for this price. There is little likelihood of the price rising in the future because raw materials only cost $16 to $20 per ton for a batch of glass containers and cullet gives the plant only $2 to $3 of input.

Purchased cullet comes from dealers who collect it from bottling plants, dairies, breweries, etc. They formerly also collected it from city dumps, but high labor costs now make this practice prohibitive. The average mix of glass containers in solid waste is 3,610 bottles per ton of solid waste.[9] Picking this many bottles by hand, separating them by color, cleaning and crushing them, removing metal rings and other impurities, and transporting them cannot be done commercially for $20 per ton. A study in Chicago in 1967 concluded that "cullet could not be profitably processed there even at the cost of $30 per ton".[10]

Cullet is being collected at 94 plants in 25 States. Most of the cullet going to these plants is collected by community groups, students, Scouts, and others who do not pay the contributors. Although the labels do not have to be removed, all metal does, including the aluminum neckrings.[11] There is little information on the amount of purchased cullet, but best estimates are 580,000 tons for the total industry, and only 100,000 tons or 1.1 percent of production for the glass container segment (Table C-2), most of which comes from bottling operations. The current recycling effort by citizens' groups (August 1971) is collecting 60,000 tons of bottles and jars per year. However, the effort is not economically viable. It depends on volunteer participation at the collection centers, highly motivated citizens, and industry subsidization to keep costs down. One industry spokesman has estimated the actual cost at $50 per ton.[12] Citizen participation probably will not grow considerably under current situations; a study of glass collection in Ann Arbor, Michigan, showed that the participants had a much higher educational and income level than the national average or even the average for Ann Arbor.

Landfill or incinerator operations are other sources of cullet which probably have the greatest potential for large-scale salvage because

Table C-2. GLASS PRODUCTION AND EXTERNAL CULLET CONSUMPTION, 1967

Segment of glass industry	Production (thousand tons)	External cullet consumption (thousand tons)	External cullet (percent)
Containers	8,950	100	1.1
Flat glass	2,150	244	11.3
Pressed and blown	1,720	256	14.9
Total	12,820	600	4.7

Source: U.S. Department of Commerce, Bureau of the Census, 1967 Census of Manufactures, Preliminary Reports, "Glass Containers," SIC 3221; "Flat Glass," SIC 3211; "Pressed and Blown Glass, n.e.c.," [not elsewhere classified] SIC 3229; Washington, October 1969; production estimate for flat glass and pressed and blown glass by MRI; external cullet consumption in containers, MRI estimate from data developed by Midwest Research Institute. Economic Study of Salvage Markets for Commodities Entering the Solid Waste Stream, December 1970, pp. 7-13.

they do not require special actions from the citizens. It is a separation rather than a collection problem. There are systems that can separate and sort glass mechanically. The Bureau of Mines has a system to extract glass from incinerator residue and to separate colored from clear glass.[13]

The Black Clawson Company has a pilot plant to treat and salvage materials that is largely based on the technology of the pulp and paper industry: glass is screened out, collected but currently is not separated by color; thus it only sells at $12 per ton.[14] Optical sorting by color is possible with existing machinery (Sortex Company) but it has not yet been applied to solid waste processing,[15] although there are plans to attach a Sortex machine to the Black Clawson plant.

Because of the problems of sorting glass by color and chemical composition, uses have been sought for mixed waste glass. The Bureau of Mines Ceramic Laboratory has developed the technology to convert glass incinerator residue into building blocks.[16] The Solid Waste Management Office of EPA has sponsored research at the University of Missouri at Rolla to use crushed waste glass as aggregate in "glassphalt" in which glass substitutes for crushed limestone. This use for waste glass would require more than the amount available and would not require much transportation because most municipalities have their own hot batch asphalt plants.[16] The process may not be economical, however, since limestone is inexpensive. Waste glass can also be used for glass wool insulation, chicken grit, specialty paints and decorations, abrasives, match heads and strikers, ammunition, and for the cleaning and tumbling of castings.[17]

C.3.2 Metal Cans

Recycling of metal cans differs for aluminum and steel cans. Aluminum cans are easy to recycle but difficult to separate from other refuse; steel cans are easy to separate magnetically but more difficult to recycle. Recent attention has centered on aluminum cans because of their salvage value. The economics of aluminum cans may be sufficiently favorable that they will be salvaged without any government incentives, but steel cans probably will require incentives before they are recycled on a large-scale.

Aluminum was an estimated 0.5 percent of municipal waste in 1968 or 968,500 tons; this amount was about 24 percent of total aluminum consumption. At the average price of $200 per ton for scrap aluminum, the potential value of aluminum in refuse was about $193.7 million. There is an active market in scrap aluminum with dealer's prices ranging from $155 per ton to $290 per ton depending on the form. Scrap aluminum prices at the smelter are $280 to $355 per ton.[18] During the 1960-68 period, the average selling price of secondary aluminum (made from scrap) was $470 per ton, or $63 below primary alloy. Not only is secondary aluminum interchangeable with primary alloy for most purposes, but it requires a much smaller investment and lower operating costs to produce.

Reynolds Aluminum, which collected aluminum oil cans in the 1950's and aluminum roofing and siding in the 1960's, set up an experimental program to collect aluminum cans in 1967 in Miami, Florida. It did not succeed because of high collection costs.[18] A second experiment undertaken in Los Angeles in 1969 using a single reclamation center revealed that 30 tons per month had to be collected to break even, according to Reynolds. There are now collection points operated by beer and soft drink distributors and the three major primary aluminum producers in 10 Western States. It was expected that up to 4 percent of total aluminum cans consumed in Los Angeles would be recovered in 1971. Similar programs operated by aluminum producers and bottlers may recover up to 30 percent of all aluminum cans.[18]

While collection may recover 30 percent of aluminum beverage containers and thus solve one-third of this part of the beverage container problem, it may also reduce the likelihood of success of a broader recovery program. The scrap value of aluminum in municipal solid waste stream is 10 times higher per pound than any other material. If present trends continue, aluminum will be the single most valuable component. Aluminum could be recovered from incinerator residue by selective distillation--each metal melts at a different temperature and thus can be captured. Other techniques under consideration are optical, mechanical, and chemical means that will separate nonferrous metals from municipal refuse before incineration.[19]

Steel cans offer less recycling opportunities than aluminum cans because of their low value as scrap even though they are easily separated magnetically from municipal refuse. Until recently, most steel cans were contaminated by about 0.5 percent of tin.[20] Because tin forms hard spots in steel, tin cans have traditionally been unacceptable in scrap. The only use for old tin cans, other than in sash weights and other ballasts, is as precipitation iron in a leaching process for the beneficiation of copper ore. This use is limited because of the small market, high transportation costs, and the need to incinerate and shred the cans. Only about 600,000 tons of old steel cans were thus consumed in 1968, and the upper limit would be 1,500,000 tons if all precipitation iron were supplied by tin cans. Since the total production of all metal cans (aluminum cans get mixed into those used by the copper producers) was 6 million tons in 1967, this use will not solve the solid waste problem.

Detinning of tin cans is not a major source of tin and/or steel scrap because of market forces rather than technical problems even though the aluminum ends of steel cans cause problems. The profit margin is too slim to permit the cleaning of used tin cans prior to detinning. The economics might change, however, if the detinning plants could obtain used tin cans at sufficiently low costs.[21]

The current trend of lower tin content to tin-free steel cans should encourage recycling of steel cans.[22] On June 23, 1971, the major producers of steel for cans announced a program to recycle steel cans: a total of 244 collection stations will accept cans but will not pay for them because steel is so inexpensive; they propose to make donations to the communities where the cans are collected. This program began when research showed that the contaminants in the cans are diluted by the large quantities of scrap and ore used in the furnaces. The possibility of legislation banning nonrefillable containers also was a significant influence.[23]

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Appendix D: RESOURCE REQUIREMENTS OF MAJOR CONSUMER EXPENDITURES

D.1 Introduction

The input-output table of the U.S. economy developed by the U.S. Department of Commerce can provide insight regarding the resource requirements of major consumer expenditure items.

Input-output is a method for taking into account the interdependence among the industries or sectors of an economy. The method of presenting this interdependence is by arraying the industries in an economy in matrix form with each industry entered in both the row and column of the matrix. When in a row, the industry is a producer with the entries in the matrix across the row showing the industry's distribution of sales. When in a column, the industry is a purchaser with the entries in the matrix down the column showing the industry's distribution of purchases.

In addition to the interindustry sales and purchases, the input-output table also has a set of final demand columns (purchases by consumers, business investment, government, and foreigners) and a value-added row (employee compensation, profits, depreciation, and indirect business taxes).

D.2 Review of Input-Output Analysis

The total output of any industry can be represented by the following equation:

$$\sum_{j=1}^{n} x_{ij} + c_i + i_i + g_i + t_i = x_i \ (i = 1 \ldots, n) \ , \qquad \text{(D-1)}$$

where:

x_{ij} = amount of output that industry _i_ sells to industry _j_,

c_i = personal consumption expenditures for the output of industry _i_,

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i_i = private investment,

g_i = government purchases,

t_i = net exports,

x_i = total output of industry i.

Although input-output tables are initially developed with transactions estimates of interindustry sales and final demand purchases, the table's usefulness is greatly increased when the transactions are converted into a system of technical coefficients of production. The technical or input coefficient is the ratio of input to output and can be written as follows:

$$a_{ij} = \frac{x_{ij}}{x_j} , \tag{D-2}$$

where:

a_{ij} = technical coefficient,

x_{ij} = amount of output of industry i purchased by industry j,

x_j = total input of industry j.

The complete set of technical coefficients arranged in matrix form show the structure of production of the economy.

By substituting the value of x_{ij} from equation D-2 into equation D-1 yields

$$x_i = \sum_{j=1}^{n} a_{ij}x_j + (c_i + i_i + g_i + t_i) . \tag{D-3}$$

In matrix notation this can be expressed as:

$$x = Ax + f ,$$

where:

f = the final demand vector $c + i + g + t$.

This is equivalent to:

$$x - Ax = f$$

$$(I-A)x = f$$

where:

I = the identity matrix.

Solving for x, total output:

$$x = (I-A)^{-1}f \; . \qquad \text{(D-4)}$$

Or, rewriting equation D-4:

$$\begin{aligned}
x_1 &= r_{11}f_1 + r_{12}f_2 + \cdots r_{1n}f_n \\
x_2 &= r_{21}f_1 + r_{22}f_2 + \cdots r_{2n}f_n \\
&\;\;\vdots \\
x_n &= r_{n1}f_1 + r_{n2}f_2 + \cdots r_{nn}f_n
\end{aligned}$$

The r_{ij} is the total requirements, direct and indirect, of industry $\underline{i}$ necessary for industry $\underline{j}$ to deliver a dollar's worth of output to final demand. It differs from a_{ij} in that it includes the indirect requirements as well as the direct requirements shown in a_{ij}. The difference in perspective can be illustrated by taking an example from the 1963 national table. The technical coefficient (a_{ij}) of the motor vehicle industry for steel is 0.0863. That is, each dollar of output of motor vehicles requires 8.6 cents of direct steel purchases. However, to build a motor vehicle requires other inputs which, in turn, require steel as an input. The technical coefficient for the rubber and miscellaneous plastics products used by the motor vehicle industry is, for example, 0.0223, but to produce rubber requires a direct input of steel of 0.0051. The total requirements of the motor vehicle industry for steel (r_{ij}) which include all the indirect steel requirements of the type cited above as well as the direct requirements is 0.2121.

D.3 Resource Requirements

By combining the total requirements table with another table developed by the U.S. Department of Commerce which shows the industrial composition of the major consumer expenditure items, one can identify the total inputs required for each consumption item. While focusing on natural resources and secondary energy (electricity), we calculated the amount of seven resources in the input-output table per dollar of consumer purchases for 83 major expenditure items. These resource requirements are tabulated in Table D-1. As the table shows, there are substantial differences in the natural resource requirements of consumer expenditures.

Table D-1. NATURAL RESOURCE REQUIREMENTS FOR MAJOR PERSONAL CONSUMPTION EXPENDITURES

Each entry represents the output required, directly and indirectly, from the industry named at the head of the column for each dollar of consumer purchases within the group of products named at the beginning of the row.		Iron and ferroalloy ores mining	Nonferrous metal ores mining	Coal mining	Crude petroleum and natural gas	Stone & clay mining and quarrying	Chemical and fertilizer mineral mining	Electric, gas, water, and sanitary services
Personal consumption expenditure categories		Col.A	Col.B	Col.C	Col.D	Col.E	Col.F	Col.G
I	FOOD AND TOBACCO							
1	Food purchased for off-premise consumption (NDC)	0.00097	0.00059	0.00230	0.01295	0.00163	0.00107	0.02588
2	Purchased meals and beverages (NDC)	0.00072	0.00049	0.00196	0.01128	0.00124	0.00078	0.02707
3	Food furnished gov't (inc. military) and commercial employees (NDC)	0.00117	0.00066	0.00257	0.01362	0.00188	0.00136	0.02523
4	Food produced and consumed on farms (NDC)	0.00102	0.00076	0.00211	0.01903	0.00306	0.00234	0.02341
5	Tobacco products (NDC)	0.00041	0.00046	0.00136	0.00823	0.00102	0.00082	0.01644
II	CLOTHING, ACCESSORIES, AND JEWELRY							
1	Shoes and other footwear (NDC)	0.00066	0.00071	0.00218	0.00842	0.00091	0.00113	0.02358
2	Shoe cleaning and repair (S)	0.00058	0.00082	0.00157	0.00975	0.00124	0.00056	0.02712
3A	Women's and children's clothing and accessories except footwear (NDC)	0.00052	0.00065	0.00215	0.00929	0.00083	0.00130	0.02507

Table D-1 (continued). NATURAL RESOURCE REQUIREMENTS FOR MAJOR PERSONAL CONSUMPTION EXPENDITURES

Personal consumption expenditure categories		A	B	C	D	E	F	G
3B	Men's and boys' clothing except footwear (NDC)	0.00052	0.00061	0.00206	0.00912	0.00078	0.00122	0.02466
4	Standard clothing issued to military personnel (NDC)	0.00096	0.00110	0.00380	0.01279	0.00136	0.00312	0.03109
5	Cleaning, dyeing, pressing, alteration, storage, and repair of garments (S)	0.00058	0.00082	0.00157	0.00975	0.00124	0.00056	0.02712
6	Laundering in establishments (S)	0.00058	0.00082	0.00157	0.00975	0.00124	0.00056	0.02712
7	Jewelry and watches (DC)	0.00179	0.00301	0.00239	0.00919	0.00122	0.00085	0.02559
8	Other clothing and accessories (S)	0.00058	0.00082	0.00157	0.00975	0.00124	0.00056	0.02712
III	PERSONAL CARE							
1	Toilet articles and preparations (NDC)	0.00212	0.00209	0.00287	0.01207	0.00160	0.00267	0.02735
2	Barbershops, beauty parlors, and baths (S)	0.00058	0.00082	0.00157	0.00975	0.00124	0.00056	0.02712
IV	HOUSING							
1	Owner occupied nonfarm dwellings--space rental value (S)	0.00050	0.00050	0.00095	0.00804	0.00196	0.00041	0.00964

Table D-1 (continued). NATURAL RESOURCE REQUIREMENTS FOR MAJOR PERSONAL CONSUMPTION EXPENDITURES

Personal consumption expenditure categories		A	B	C	D	E	F	G
2	Tenant occupied nonfarm dwellings (inc. lodging houses) (S)	0.00050	0.00050	0.00096	0.00806	0.00195	0.00041	0.00988
3	Rental value of farmhouses (S)	0.00050	0.00050	0.00095	0.00804	0.00196	0.00041	0.00964
4	Other housing (S)	0.00058	0.00082	0.00157	0.00975	0.00124	0.00056	0.02712
V	HOUSEHOLD OPERATION							
1	Furniture, including mattresses and bedsprings (DC)	0.00192	0.00160	0.00258	0.00962	0.00106	0.00086	0.02610
2	Kitchen and other household appliances (DC)	0.00507	0.00557	0.00421	0.00963	0.00194	0.00090	0.02595
3	China, glassware, tableware, and utensils (DC)	0.00348	0.00342	0.00390	0.01036	0.00632	0.00129	0.03244
4	Other durable house furnishings (DC)	0.00220	0.00369	0.00302	0.01067	0.00226	0.00135	0.02803
5	Semidurable house furnishings (NDC)	0.00086	0.00102	0.00266	0.01101	0.00113	0.00164	0.02937
6	Cleaning and polishing preparations, misc. household supplies (NDC)	0.00184	0.00211	0.00445	0.01470	0.00649	0.00417	0.03245
7	Stationery and writing supplies (NDC)	0.00102	0.00132	0.00402	0.01211	0.00222	0.00281	0.03117
8A	Electricity (S)	0.00063	0.00053	0.03483	0.09432	0.00150	0.00040	1.25649

Table D-1 (continued). NATURAL RESOURCE REQUIREMENTS FOR MAJOR PERSONAL CONSUMPTION EXPENDITURES

Personal consumption expenditure categories		A	B	C	D	E	F	G
8B	Gas (S)	0.00063	0.00053	0.03483	0.09432	0.00150	0.00040	1.25649
8C	Water and other sanitary services (S)	0.00067	0.00057	0.03175	0.08235	0.00183	0.00049	1.06368
8D	Other fuel and ice (NDC)	0.00093	0.00081	0.05047	0.26283	0.00327	0.00115	0.04419
9	Telephone and telegraph (S)	0.00018	0.00027	0.00073	0.00574	0.00065	0.00011	0.01678
10	Domestic service (S)							
11	Other household operation expenditure (S)	0.00047	0.00050	0.00610	0.01102	0.00087	0.00035	0.02348
VI	MEDICAL CARE EXPENSES							
1	Drug preparations and sundries (NDC)	0.00116	0.00115	0.00258	0.01200	0.00153	0.00244	0.02771
2	Ophthalmic products and orthopedic appliances (DC)	0.00090	0.00186	0.00204	0.00932	0.00095	0.00090	0.02626
3	Physicians (S)	0.00029	0.00032	0.00203	0.00782	0.00079	0.00034	0.04182
4	Dentists (S)	0.00029	0.00032	0.00203	0.00782	0.00079	0.00034	0.04182
5	Other professional medical services (S)	0.00029	0.00032	0.00203	0.00782	0.00079	0.00034	0.04182

Table D-1 (continued). NATURAL RESOURCE REQUIREMENTS FOR MAJOR PERSONAL CONSUMPTION EXPENDITURES

Personal consumption expenditure categories		A	B	C	D	E	F	G
6	Privately controlled hospitals and sanitariums (S)	0.00029	0.00032	0.00203	0.00782	0.00079	0.00034	0.04182
7	Health insurance (S)	0.00019	0.00021	0.00172	0.00619	0.00052	0.00023	0.03425
VII	PERSONAL BUSINESS							
1	Brokerage charges and investment counseling (S)	0.00019	0.00021	0.00172	0.00619	0.00052	0.00023	0.03425
2	Bank service charges, trust services, and safety deposit box rental (S)	0.00019	0.00021	0.00172	0.00619	0.00052	0.00023	0.03425
3	Services rendered without payment by financial intermediaries except insurance companies (S)	0.00019	0.00021	0.00172	0.00619	0.00052	0.00023	0.03425
4	Expenses of handling life insurance (S)	0.00019	0.00021	0.00170	0.00612	0.00051	0.00023	0.03388
5	Legal services (S)	0.00047	0.00057	0.00191	0.00711	0.00077	0.00067	0.02728
6	Funeral and burial expenses (S)	0.00067	0.00073	0.00193	0.00975	0.00471	0.00066	0.02527
7	Other personal business (S)	0.00033	0.00038	0.00698	0.00753	0.00077	0.00041	0.03650
VIII	TRANSPORTATION							
1A	New cars and net purchases of used cars (DC)	0.00777	0.00391	0.00542	0.00903	0.00172	0.00074	0.02769

Table D-1 (continued). NATURAL RESOURCE REQUIREMENTS FOR MAJOR PERSONAL CONSUMPTION EXPENDITURES

Personal consumption expenditure categories		A	B	C	D	E	F	G
1B	Tires, tubes, accessories, and parts (DC)	0.00193	0.00304	0.00350	0.01256	0.00197	0.00321	0.03141
1C	Automobile repair, greasing, washing, parking, storage, and rental (S)	0.00153	0.00123	0.00198	0.01045	0.00179	0.00048	0.02127
1D	Gasoline and oil (NDC)	0.00061	0.00066	0.00195	0.23485	0.00291	0.00082	0.03336
1E	Bridge, tunnel, ferry, and road tolls (S)	0.00086	0.00078	0.01758	0.02397	0.00357	0.00097	0.12956
1F	Automobile insurance premiums less claims paid (S)	0.00019	0.00021	0.00172	0.00619	0.00052	0.00023	0.03425
2A	Street and electric railway and local bus transportation (S)	0.00088	0.00058	0.00187	0.02605	0.00118	0.00032	0.01936
2B	Taxicab transportation (S)	0.00088	0.00058	0.00187	0.02605	0.00118	0.00032	0.01936
2C	Railway (commutation) transportation (S)	0.00088	0.00058	0.00187	0.02605	0.00118	0.00032	0.01936
3A	Railway (excluding (commutation) and sleeping and parlor car (S)	0.00088	0.00058	0.00187	0.02605	0.00118	0.00032	0.01936
3B	Intercity bus transportation (S)	0.00088	0.00058	0.00187	0.02605	0.00118	0.00032	0.01936
3C	Airline transportation (S)	0.00088	0.00058	0.00187	0.02605	0.00118	0.00032	0.01936

Table D-1 (continued). NATURAL RESOURCE REQUIREMENTS FOR MAJOR PERSONAL CONSUMPTION EXPENDITURES

Personal consumption expenditure categories		A	B	C	D	E	F	G
3D	Other intercity transportation (S)	0.00088	0.00058	0.00187	0.02605	0.00118	0.00032	0.01936
IX	RECREATION							
1	Books and maps (DC)	0.00053	0.00063	0.00253	0.00879	0.00133	0.00129	0.02353
2	Magazines, newspapers, and sheet music (NDC)	0.00057	0.00068	0.00269	0.00926	0.00142	0.00138	0.02445
3	Nondurable toys and sport supplies (NDC)	0.00176	0.00309	0.00249	0.00955	0.00127	0.00105	0.02507
4	Wheel goods, durable toys, sport equipment, boats, pleasure aircraft (DC)	0.00373	0.00357	0.00345	0.00921	0.00133	0.00092	0.02636
5	Radio and television receivers, records, and musical instruments (DC)	0.00163	0.00352	0.00206	0.00790	0.00103	0.00060	0.02292
6	Radio and television repair (S)	0.00058	0.00082	0.00157	0.00975	0.00124	0.00056	0.02712
7	Flowers, seeds and potted plants (NDC)	0.00058	0.00059	0.00149	0.01676	0.00225	0.00165	0.02503
8A	Motion picture theaters (S)	0.00033	0.00042	0.00117	0.00624	0.00071	0.00059	0.02400
8B	Legitimate theaters and opera, and entertainments of nonprofit institutions (excluding athletics) (S)	0.00033	0.00042	0.00117	0.00624	0.00071	0.00059	0.02400
8C	Spectator sports (S)	0.00033	0.00042	0.00119	0.00625	0.00072	0.00060	0.02400

Table D-1 (continued). NATURAL RESOURCE REQUIREMENTS FOR MAJOR PERSONAL CONSUMPTION EXPENDITURES

Personal consumption expenditure categories		A	B	C	D	E	F	G
9	Clubs and fraternal organizations except insurance (S)	0.00029	0.00032	0.00203	0.00782	0.00079	0.00034	0.04182
10	Commercial participant amusements (S)	0.00037	0.00043	0.00122	0.00756	0.00074	0.00057	0.02369
11	Parimutual net receipts (S)	0.00033	0.00042	0.00117	0.00624	0.00071	0.00059	0.02400
12	Other recreational expenditure (S)	0.00043	0.00047	0.00152	0.00813	0.00095	0.00054	0.02728
X	PRIVATE EDUCATION AND RESEARCH							
1	Private higher education (S)	0.00029	0.00032	0.00203	0.00782	0.00079	0.00034	0.04182
2	Private elementary and secondary schools (S)	0.00029	0.00032	0.00203	0.00782	0.00079	0.00034	0.04182
3	Other private education and research (S)	0.00029	0.00032	0.00203	0.00782	0.00079	0.00034	0.04182
XI	RELIGIOUS AND WELFARE ACTIVITIES							
1	Religious and welfare (S)	0.00029	0.00032	0.00203	0.00782	0.00079	0.00034	0.04182
XII	FOREIGN TRAVEL AND OTHER, NET							
1	Foreign travel by U.S. residents (S)	0.00014	0.00009	0.00029	0.00400	0.00018	0.00005	0.00297
2	Expenditures abroad by U.S. government personnel (military and civilian) (NDC)	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

(See next page for footnotes.)

Table D-1 (continued). NATURAL RESOURCE REQUIREMENTS FOR MAJOR PERSONAL CONSUMPTION EXPENDITURES

Code (following group titles):
DC - consumer durable commodities
NDC - nondurable commodities
S - services

Source: Survey of Current Business, Vol. 49, No. 11 (November 1969), and Vol. 51, No. 1 (January 1971).

Appendix E: ELASTICITY OF DEMAND

E.1 Introduction

The elasticity of demand is a measure of the responsiveness of demand to a change in one of its determinants: own price, the price of other commodities, or the income of buyers. It is often expressed as the percentage change in the quantity demanded in response to a 1 percent change in the price or other determinant. Demand is considered to be elastic if the elasticity coefficient is less than -1 (e.g., -1.2). This implies that total revenue (quantity times price) will decrease when price rises. If total revenue increases with a price increase, the elasticity coefficient is greater than -1 (e.g. -0.8) and demand is inelastic. If the elasticity coefficient is equal to -1, then there is no change in total revenue as prices change and the elasticity is unitary.

The income elasticity of demand is the ratio of the relative change in the quantity demanded of a commodity to the relative change in income. The cross-elasticity of demand is the ratio of the relative change in the quantity demanded of one product to the relative change in price of another related product. One attempt was made in this project to calculate the cross-elasticity of demand for beer as a function of distilled spirit prices, but the result was rejected as illogical, probably due to the strong correlation of the data series for beer and distilled spirits prices. This aspect of demand elasticity was not pursued further.

The price elasticity is defined as holding for a particular point on the demand curve and thus is most accurate for very small changes in price and quantity. The effects of large changes in prices cannot be determined without more knowledge of the demand curve.

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E.2 Soft Drink Consumption

The data used were for the period 1955-1970 and were U.S. aggregates. The data were converted to natural logarithms before calculation, a transformation consistent with numerous empirical demand studies and one which permits the analyst to obtain the elasticity coefficient directly from an associated regression equation. The definition of variables is as follows:

Variable	Definition
LCON	Logarithm of per capita soft drink consumption, in ounces.
LPI	Logarithm of per capita personal income in 1968 dollars. Current dollars are deflated by the GNP implicit deflator for personal consumption expenditures.
LRP	Logarithm of relative prices of soft drinks, equal to a price index for soft drinks divided by the consumer price index (1967 = 100 for each series).
LPOP	Logarithm of the percentage of the U.S. population aged 10-29.

Two prediction equations are shown below. The numbers in parentheses below the regression coefficients indicate t-values. Only one specification, that with all variables expressed in logarithms, was attempted.

$$\mathrm{LCON} = -6.0867 + \underset{(3.83)}{1.2238}\ \mathrm{LPI} - \underset{(-0.98)}{0.1599}\ \mathrm{LRP} + \underset{(1.60)}{1.1524}\ \mathrm{LPOP}$$

$$s^2_{y.x} = 0.00023 \qquad R^2 = 0.997$$

$$\mathrm{LCON} = -5.4433 + \underset{(3.95)}{1.2536}\ \mathrm{LPI} + \underset{(1.34)}{0.8989}\ \mathrm{LPOP}$$

$$s^2_{y.x} = 0.00023 \qquad R^2 = 0.997$$

With this specification, the (constant) price and income elasticities are equal to the appropriate regression coefficients. For example, from the first equation above, the income elasticity of soft drink consumption is equal to 1.22; the price elasticity is equal to -0.16.

From the t-values shown, it is seen that the price elasticity estimate is not very reliable, with the lack of precision due to the high degree of multicollinearity among the independent variables. In an attempt to overcome this difficulty, two approaches using the technique of conditional regression analysis were employed: (a) specification of a fixed ratio between income and price elasticity, and (b) specification of fixed value for the income elasticity.

The best results were obtained with a ratio of income to price elasticity of -8.0. The estimated price elasticity is -0.15, with a standard error of 0.036. The estimated income elasticity is 1.20, with a standard error of 0.288.

E.3 Beer Consumption

An identical approach was followed for beer consumption. The definitions of the variables are similar, with per capita consumption measured in ounces and the appropriate age group taken as 20-34. Results are as follows:

$$\text{LCON} = 3.0044 + \underset{(3.13)}{0.3341}\ \text{LPI} - \underset{(-0.53)}{0.1733}\ \text{LRP} + \underset{(6.35)}{0.6685}\ \text{LPOP}$$

$$s^2_{y.x} = 0.00034 \qquad R^2 = 0.937$$

$$\text{LCON} = 2.6071 + \underset{(11.82)}{0.3875}\ \text{LPI} + \underset{(6.55)}{0.6579}\ \text{LPOP}$$

$$s^2_{y.x} = 0.00033 \qquad R^2 = 0.936$$

Houthakker and Taylor, in their study Consumer Demand in the United States, reported a short run income elasticity for alcoholic beverages of 0.2898.[1] Therefore, a conditional regression with income elasticity fixed at 0.30 was attempted, with the following results:

price elasticity:	-0.27
standard error:	0.10
t-value:	-2.72

Therefore, a choice exists between the first calculated price elasticity for beer of -0.17, which is statistically insignificant, and the price elasticity for all alcoholic beverages of -0.27, which is statistically significant. Both figures show that the price elasticity of demand for beer is inelastic, although the latter figure shows a greater responsiveness to price changes than does the former. In more concrete terms, this means that if price rises by 1 percent, the quantity demanded by consumers will decline by 0.17 percent if -0.17 is used and by 0.27 percent if -0.27 is used as the own-price elasticity.

E.4 Conclusion

Both soft drinks and beer consumption were found to be rather price inelastic when there were small changes in price. For computational purposes, the price elasticities for both commodities were rounded to -0.2.

E.5 Reference

1. Houthakker, H. S., and L. D. Taylor. Consumer Demand in the United States: Analyses and Projections. 2d ed. Cambridge, Massachusetts, Harvard University Press, 1970. p. 61.

Appendix F: EMPLOYMENT AND INCOME MODELS

F.1 Introduction

One result of some proposed solutions to the beverage container problem is to change employment in some industries. Although there will be substantial reductions in some industries, there will also be offsetting increases in other industries. Redistribution of employment among industries is normal in a market economy; and yet, substantial public attention is always focused on anticipated reductions in employment. For this reason, careful attention has been devoted by RTI to the employment effects of all the solutions.

Employment models for projecting 1976 levels and estimating changes in employment due to changes in demand were developed for the soft drink, malt liquor, wholesale beer distribution, glass container manufacturing, and metal can manufacturing industries. The manpower requirements to handle empty, returned containers in supermarkets were also developed. Simple functional relationships were estimated that relate output in the beverage and beverage container industries with employment in the supplying industries.

The average earnings in these industries were calculated for 1969 in order to estimate the income effects of employment changes. Occupational distributions were used to identify the employment effects by type of occupation for the selected industries.

F.2 Employment Projections

F.2.1 Bottled and Canned Soft Drinks (SIC* 2086)

The bottled and canned soft drink industry accounts for the bulk of employment in the manufacture and distribution of soft drinks†. In 1969, this industry consisted of about 3,400 establishments and 128,600 employees. Employment has been growing at more than 2 percent annually and output at an even faster rate primarily due to the shifts toward the less labor-demanding nonrefillable container system.

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*SIC is the standard industrial classification code used to designate industries.

†The flavoring, extracts, and syrups industry, SIC 2087, provides an important input to SIC 2086, but it is unlikely to be greatly affected by any of the proposed solutions.

The soft drink industry is widely dispersed throughout the country in direct relationship to the population distribution. Because the basic flavors can be shipped and then mixed with carbonated water in the local region (thus reducing transportation charges) and because the system of refillable bottles is most efficient in relatively small geographical areas, the soft drink industry is characterized by many plants with small geographical market areas.

The typical bottling plant usually distributes its product throughout its market area by truck. The truck driver is the route salesman who takes the order, makes the delivery, puts the product on the shelves, and picks up the empties. This distribution system is labor intensive, rather than capital intensive. Production workers only amounted to 49,000 out of 128,600 in 1969; the balance of the employees were in distribution. The distribution of refillable bottles requires more labor than the distribution of nonrefillable containers because of the need to handle the empties. The major employment impact of the proposed solutions will be in distribution employment, although soft drinks in refillable containers do require a few more production employees than are necessary with nonrefillable containers.

We have projected employment in the industry by relating employment to the number of fillings. The relationship used is shown below:

$$\begin{aligned} E_1 &= 49.2276 + 0.001759\ X_1 \\ &\quad\ (6.97) \qquad (8.90) \\ R^2 &= 0.89 \quad F = 79.27 \quad D.W. = 1.22 \end{aligned} \tag{F-1}$$

where E_1 is employment, X_1 is fillings, the figures within parentheses are t-statistics, R^2 is the coefficient of determination, F is the F-statistic, and D.W. is the Durban-Watson statistic.

As shown in Table F-1, employment is projected to increase from 128,600 in 1969 to 147,700 in 1976 if present trends continue.

Table F-2 shows the distribution labor requirements for each of the three types of containers.

Table F-1. EMPLOYMENT IN THE BOTTLED AND CANNED SOFT DRINK INDUSTRY

Year	Fillings (millions)	Employment
1958	30,262	97,100
1959	32,228	100,000
1960	29,299	103,000
1961	30,754	104,100
1962	31,232	105,400
1963	32,265	106,800
1964	34,384	111,100
1965	36,993	113,900
1966	37,579	117,700
1967	40,005	123,400
1968	41,074	125,200
1969	47,906	128,600
Projected		
1976	56,017	147,700

Source: Actual data, U.S. Department of Commerce, Census of Manufactures, Survey of Manufactures; projections, Research Triangle Institute.

Table F-2. SOFT DRINK DISTRIBUTION LABOR REQUIREMENTS BY TYPE OF CONTAINER

Type of container	Labor cost per case	Cases per man-hour	Cases per man-year
Refillable bottles	\$0.405	8.15	16,300
Nonrefillable bottles	\$0.267	12.36	24,720
Cans	\$0.244	13.52	27,040

Source: Booz-Allen and Hamilton, Study of Distribution Practices in the Soft Drink Industry; and Research Triangle Institute.

Table F-3. SOFT DRINK DISTRIBUTION EMPLOYMENT

Type of container	Cases		Employment	
	1967	1976	1967	1976
Refillable bottles	1,213,728	700,200	75,858	42,957
Nonrefillable bottles	149,394	536,820	6,043	21,716
Cans	303,750	1,096,700	11,250	40,558
Total	1,666,872	2,333,720	93,141	105,231

Source: Research Triangle Institute.

Labor costs were converted to cases per man-hour by dividing the 1967 average hourly wage of $3.30 for nonproduction workers in SIC 2086 by the labor cost per case; cases per man-year were calculated by multiplying cases per man-hour by 2,000, the average number of man-hours in a man-year. The number of distribution employees shown in Table F-3 was calculated by dividing the total number of cases of each type of container by the number of man-years required.

The interesting implication of the employment requirements of the soft drink industry is that current containerization trends toward nonrefillables are resulting in a lower rate of employment growth in the soft drink industries than would be the case if all containers were refillable bottles.

F.2.2 Malt Liquor (SIC 2082)

The malt liquor industries include the brewing of beer and its distribution in areas near the brewery (wholesale beer distribution employment will be discussed in the next section). Employment in the malt liquor industry has been decreasing over time because the growth in consumption has been too slow to offset the growth in productivity. There has been a great reduction in the number of breweries, from 402 in 1950, to 220 in 1960, to 158 in 1969, in an effort to improve productivity through economies of scale.

Employment in 1976 has been estimated by projecting output, in terms of fillings per employee (O_2/E_2) as a function of time (T = 58, 59, ... 69, 76), which is the same as projecting productivity. The estimating equation was

$$\frac{O_2}{E_2} = -1150.608 + \underset{(0.443)}{24.720}\, T \qquad \text{(F-2)}$$

$$F = 137.99 \quad R^2 = 0.93 \quad \text{Standard error} = 52.773$$

where the figure within parentheses is the variance. Output per employee is projected to be 728,100 fillings by 1976. Based on our projection of fillings, malt liquor employment is projected to be 62,000. Malt liquor employment, therefore, will increase between 1969 and 1976 due to the expected accelerated growth in beer consumption. (See Table F-4).

Table F-4. EMPLOYMENT IN THE MALT LIQUOR INDUSTRY

Year	Output per employee (thousands)	Fillings (millions)	Employment (thousands)
1958	310.4	22,658	71.7
1959	337.8	23,949	70.9
1960	322.3	22,497	69.8
1961	340.2	23,199	68.2
1962	364.0	24,026	66.0
1963	392.8	24,589	62.6
1964	416.2	25,762	61.9
1965	434.0	26,212	60.4
1966	457.6	27,685	60.5
1967	508.6	30,771	60.5
1968	539.5	32,263	59.8
1969	600.5	34,891	58.1
Projected			
1976	728.1	45,169	62.0

Source: Actual data, U.S. Department of Commerce, Census of Manufactures, Survey of Manufactures; projections, Research Triangle Institute.

Employment changes in the malt liquor industry due to a proposal are related to changes in consumption and/or containerization. The above equation was used to calculate employment changes as a result of a change in total fillings (consumption). Containerization changes primarily affects beer distribution employment which is in two industries: malt liquor and wholesale distribution of beer. In order to identify the beer distribution employment share of total employment in malt liquors, we had to first estimate the employment necessary to distribute all packaged beer, then estimate and subtract out the wholesale beer distribution share.

The combined total malt liquor and wholesale beer distribution employment was projected to be 80,000 using the same per case labor requirements as estimated above for soft drinks. The calculations are shown in Table F-5. Although beer travels longer distances to the retailer from the brewery than do soft drinks from the bottler, the soft drink distribution labor requirement probably is a reasonable approximation of the labor required for beer distribution. The shipment from the brewery to the local distributor is frequently made by common carrier which would not have a high labor requirement on a per case basis, though the costs may be high. The distributor receives the beer at his warehouse and then distributes it to retail outlets. This latter stage of distribution is similar to the distribution of soft drinks by a bottler who might be located in the same city as the beer distributor.

Table F-5. BEER DISTRIBUTION EMPLOYMENT, 1976

Type of container	Projected cases of beer (thousands)	Cases per man-year	Projected distribution employment (thousands)
Refillable bottles	357,590	16,300	21.9
Nonrefillable bottles	489,333	24,720	19.8
Cans	1,035,128	27,040	38.3
Total	1,882,051	68,060	80.0

Source: Research Triangle Institute.

A total of 70,900 employees is projected to be in the wholesale beer distribution industry (see the next section). Of these, 58,800 distribute packaged beer and the remaining 12,100 distribute bulk beer. The difference between the total distribution employment for packaged beer (80,000) and the wholesale beer distribution share (58,800) is 21,200. It is assumed that the malt liquor industry employs these people to distribute packaged beer.

F.2.3 Wholesale Distribution of Beer (SIC 5095)

Most beer in the United States is distributed by a decentralized system of independent wholesalers rather than directly by breweries. Because the relatively small number of breweries (158 in 1969) are concentrated in a few parts of the country, it is not economical for the beer to be shipped directly from breweries to the retail outlets located in many parts of the country.

Employment in the wholesale distribution of beer was projected by relating employment to total beer consumption. The relationship is:

$$E_3 = 17.883 + \underset{(0.029)}{0.363}\, C \qquad \text{(F-3)}$$

$$F = 155.417 \quad R^2 = 0.99$$

Standard error of the estimate = 0.485

where E_3 is employment, C is beer consumption, and the figure within parentheses is the standard error of C.

By solving the equation for projected 1976 consumption levels, we project employment of 70,900 (see Table F-6).

Table F-6. EMPLOYMENT IN WHOLESALE DISTRIBUTION OF BEER

Selected Year	Consumption (million barrels)	Employment (thousands)
1963	92.3	51.5
1967	109.3	57.2
1969	114.9	59.9
Projected		
1976	145.9	70.9

Source: Research Triangle Institute.

Since labor productivity has been and is projected to continue to increase slower in the wholesale distribution of beer than in the production of beer, employment in the wholesale distribution of beer will increase faster than in the malt liquor industry.

It was assumed that the wholesale beer distribution industry distributes beer in the same proportion as it is produced, and that employment is proportional with the types of beer. That is, of all beer distribution employees, 17 percent distribute beer in bulk, while the remaining 83 percent or 58,800 distribute packaged beer.

F.2.4 Glass Container Manufacturing (SIC 3221)

In 1967 the glass container manufacturing industry comprised 40 companies that operated about 120 plants and employed about 66,000 people. Employment increased to 76,000 by 1970 mainly because of increased beverage container production, which grew at a much faster rate than container production for food and other products. The percentage of total containers represented by beverage containers grew from 14.8 percent in 1958 to 42.4 percent in 1969. The share should reach 56.9 percent by 1976.

Nonrefillable beer and soft drink bottle production is responsible for most of the growth in glass container production. It has increased from 6.9 percent of the total glass containers produced in 1958 to 36.5 percent in 1969. Nonrefillables accounted for 75.5 percent of the growth in total glass container production from 1958 to 1969.

Output per employee in glass container manufacturing was projected on the basis of time (T = 58, 59, ... 69, 76), in order to obtain the 1976 output-employment relationship. The relationship determined was:

$$\frac{O_4}{E_4} = -268.6504 + 9.0385\ T$$

$$F = 312.51 \quad R^2 = 0.97 \quad \text{Standard error} = 31.151\ . \qquad \text{(F-4)}$$

Using this equation with our projections of 1976 containerization, we project 1976 glass container employment to be 76,800 (see Table F-7). The equation can be solved to determine the employment impacts of changes in the demand for glass containers.

Table F-7. EMPLOYMENT IN THE GLASS CONTAINER INDUSTRY

Year	Container output (thousand gross)	Container output per employee (gross)	Employment (thousands)
1958	143,366	2,611.4	54.9
1959	153,102	2,724.2	56.2
1960	156,799	2,680.3	58.5
1961	165,656	2,751.7	60.2
1962	174,195	2,903.2	60.0
1963	177,886	2,964.8	60.0
1964	186,741	3,091.7	60.4
1965	198,131	3,221.6	61.5
1966	206,299	3,198.4	64.5
1967	231.046	3,463.9	66.7
1968	223,635	3,494.3	64.0
1969	252,360	3,529.5	71.5
Projected			
1976	321,096	4,182.8	76.8

Source: Actual data, U.S. Department of Commerce, Census of Manufactures, Survey of Manufactures; projections by Research Triangle Institute.

Table F-8. SELECTED DATA ON THE GLASS CONTAINER INDUSTRY

Year	Employment (thousands)	Value added (millions)	Wages & salary (millions)	Profits* (millions)	New capital expenditures (millions)	Productivity index (1967=100.0)
1958	54.9	$532.5	$259.9	$261.5	$ 31.2	78.7
1959	56.2	561.3	271.9	376.8	32.9	82.3
1960	58.5	567.5	298.3	312.7	34.8	81.5
1961	60.2	601.2	314.5	298.5	68.9	82.3
1962	60.0	613.0	326.7	309.8	53.6	86.1
1963	60.0	629.6	328.0	330.2	53.8	89.1
1964	60.4	646.6	340.9	347.6	59.5	92.4
1965	61.5	679.4	358.3	440.5	72.3	96.7
1966	64.5	763.1	391.3	393.9	116.8	97.2
1967	66.7	842.9	426.1	349.3	75.5	100.0
1968	64.0	905.0	436.1	NA+	74.4	101.0
1969	71.5	1,111.6	518.8	NA	131.9	106.1

Source: From U.S. Department of Commerce, 1967 Census of Manufactures and 1969 Annual Survey of Manufactures. U.S. Bureau of Labor Statistics, Employment and Earnings, Vol. 17 (March 1971) and Indexes of Output Per Man-Hour, Selected Industries, 1939 and 1947-1970, Bulletin 1692. U.S. Internal Revenue Service, Statistics of Income: Corporation Income Tax Returns.

*Includes profits for Glass and Glass Products, on returns with net income subject to income tax.

+NA - Not available.

By using the average output of 4,182.76 gross of containers per worker projected for 1976, it is estimated that if 171,027,000 gross of containers were eliminated by a ban on nonrefillable beer and soft drink bottles, it would cause an employment drop of 40,900. This drop would be partially offset by an employment increase of 8,000 needed to produce more refillable bottles (assuming trippage of 15) to replace the nonrefillable bottles and cans. Table F-8 provides selected data on the glass container industry.

F.2.5 Metal Can Industry (SIC 3411)

The metal can industry manufactures its can from tinplate, double-rolled tin-free steel, and from aluminum sheets, plates, and other aluminum mill shapes. There were about 300 establishments in the metal can industry in 1967 concentrated in Illinois, California, New Jersey, Pennsylvania, and Maryland employing about 60,000 people. Employment was static in the early 1960's; it grew fairly rapidly toward the end of the decade. (Table F-9 contains selected data on the industry.)

Table F-9. SELECTED DATA ON THE METAL CAN INDUSTRY

Year	Employment (thousands)	Value added (millions)	Wages and salaries (millions)	Profits (millions)	New capital expenditures (millions)
1958	54.2	$ 668.6	$303.9	$152.1	$ 54.3
1959	53.8	668.3	332.1	137.0	50.8
1960	53.6	666.2	333.6	108.1	68.4
1961	53.4	758.7	347.6	173.9	47.9
1962	53.1	772.4	369.3	140.7	60.0
1963	53.2	830.5	377.0	102.3	66.5
1964	55.1	932.4	400.6	139.9	71.8
1965	54.9	1,011.4	422.3	188.2	79.4
1966	58.7	1,043.5	446.9	*	99.5
1967	60.4	1,146.1	475.8	275.4	100.0
1968	63.7	1,337.7	542.3	NA+	119.1
1969	68.1	1,454.6	597.0	NA	143.2

Source: From U.S. Department of Commerce, *1967 Census of Manufactures* and *1969 Annual Survey of Manufactures*. U.S. Bureau of Labor Statistics, *Employment and Earnings*, Vol 17 (March 1971) and *Indexes of Output Per Man-Hour, Selected Industries, 1939 and 1947-1970*, Bulletin 1692. U.S. Internal Revenue Service, *Statistics of Income: Corporation Income Tax Returns*.

*High sampling variability.

+NA - Not available.

Table F-10. METAL CAN EMPLOYMENT

Year	Container output (billions)	Container output per employee (thousands)	Employment (thousands)
1960	44.372	827.8	53.6
1961	45.593	853.8	53.4
1962	48.162	907.0	53.1
1963	45.904	862.9	53.2
1964	49.125	891.6	55.1
1965	50.464	919.2	54.9
1966	54.521	928.8	58.7
1967	56.866	941.5	60.4
1968	62.456	980.5	63.7
1969	65.684	964.5	68.1
Projected			
1976	93.441	1083.0	86.3

Source: Actual data from U.S. Department of Commerce, Census of Manufactures and Survey of Manufactures; projections by Research Triangle Institute.

Total employment for 1976 was estimated by projecting output per employee as a function of time (T = 58, 59, ... 69, 76). The relationship is shown below:

$$\frac{O_5}{E_5} = -7.5388 + 1.5242\ T \qquad \text{(F-5)}$$

$$F = 57.70 \quad R^2 = 0.88 \quad \text{Standard error} = 2.66\ .$$

Output per employee is projected to rise to 1,083,000 cans per year by 1976. With our projections for 93.441 billion cans of all types, this output per employee generates employment of 86,300 in 1976 (see Table F-10).

Beer and soft drink containers have been an increasing percentage of total can output: 22 percent in 1960, 43 percent in 1969, and a projected 55 percent in 1976. More than 47,200 people will be required to produce beverage cans in 1976 if present trends continue.

F.2.6 Grocery Stores (refillables handling only) (SIC 5411)

Refillable beverage containers impose a burden on retailers that nonrefillables do not: the cashier rings up deposits and refunds them; the bookkeeper keeps track of deposits; and busboys (or higher level employees) handle, sort, move, and check the empties to the truck driver. However, costs for these tasks may be offset, at least in part, by higher profit margins although some believe that nonrefillables are more profitable than refillables when all costs such as storage space, equipment cost, and inventory charges are considered. A study of a few supermarkets in Missouri concluded that profits were greater on nonrefillables than on refillables.[1] In these stores the markups were higher on nonrefillables than on refillables. However, the evidence is not convincing since the margins between wholesale and retail prices in the referenced study were not typical and some of the handling costs attributed to refillables do not appear warranted in the example cited. Only the higher labor requirements for retail stores imposed by refillable bottles will be examined in this section because the markup should include allowance for the nonlabor costs.

We have used the results of a study based on California supermarkets to estimate the handling requirements of refillable bottles. Table F-11 gives man-hours per bottle by task at a representative chain. The total number of man-hours per refillable bottle is 0.0028335. A full-time employee is required for every 14,000 bottles returned.

We have assumed that additional employees will be required to handle refillable bottles only at grocery stores grossing more than $500,000 annually (smaller grocery stores are probably able to handle the empties without adding extra workers). Soft drink sales are about 2 percent of total grocery store sales. When total grocery sales are $10,000 weekly or $500,000 annually (a small grocery store), weekly soft drink sales would be $200 or about 65 cases. If 70 percent of the 65 cases are refillables, this would require less than 1/10 of an employee. This task would probably be handled by someone with other tasks since total employment would probably average only about 5 people.

In 1970, 31,000 grocery stores with sales of more than $500,000 annually accounted for 76.4 percent of all grocery store sales.

Table F-11. MAN-HOURS PER REFILLABLE BOTTLE FOR NINE CATEGORIES OF LABOR COSTS

Labor category	Man-hours per bottle
Accounting	0.0000073
Clerk ringing deposits	0.0000958
Clerk refunding deposits	0.0001846
Busboy racking empties	0.0005158
Moving rack to bottle storage area	0.0003900
Clearing of bottle storage area	0.0001900
Sorting of bottles from rack	0.0010000
Moving empty rack to front	0.0003900
Checking empties to driver	0.0000600
Total	0.0028335

Source: Bottle Survey '71. A California Supermarket Report on the Cost of Handling Returnable Soft Drink Bottles. La Habra, Calif., Alpha Beta Acme Markets, 1971.

Grocery stores have about 55 percent of total soft drink sales, and cash-and-carry stores have another 6 percent, as shown in Appendix B. If all grocery stores sell 61 percent of all soft drinks and the large grocery stores have 76.4 percent of all grocery stores sales, then the large grocery stores would sell 47 percent of fillings. If we assume that these percentages will remain the same in 1976 and that grocery stores sell the same proportion of refillable bottles as the national average, then in 1976, 7,898,330,000 refillable bottles of soft drinks will be sold in large grocery stores. If the same amount of labor per bottle is required in 1976 as 1969, these refillable bottles will require the employment of 11,058 people. If the percentage of soft drink sales in refillable bottles increases from 30 to 100 percent, an additional 25,801 employees will be required to handle the empty soft drink bottles.

Currently, only a small share of beer is sold in refillable bottles through grocery stores and none is forecast for 1976. It is likely that refillable beer bottles would require the same amount of handling in 1976 as refillable soft drink bottles if they were sold in grocery stores. Grocery stores in 1970 sold 81 percent of all bottled and canned beer sold for off-premise consumption. Large stores (sales over $500,000 annually) accounted for 62 percent of off-premise sales and probably at least 42 percent of all beer sales in nonrefillable containers. If all beer is sold in refillable packages, large grocery stores would handle about 19.0 billion empties and need to employ about 26,559 people in 1976 for this purpose.

F.2.7 Metal Suppliers (SIC 3312, 3334, and 3352)

The blast furnace and steel mill industry (SIC 3312) supplies all the steel tinplate to the metal can industry. The primary producers of aluminum (SIC 3334) and the aluminum rolling and drawing industry (SIC 3352) provide all the aluminum used by the metal can industry. In 1969, beverage containers accounted for 2.0 percent of all steel consumption and 5.6 percent of all aluminum consumption. Employment in these supplying industries due to beverage cans usage was assumed to be proportional to the percentage of output consumed by the beverage container industry. The proportional employment was 10,600 employees in the steel and 4,700 employees in the aluminum industries. Employment in the metals industries due to beverage cans was projected to increase at the same rate as the employment in the metal can industry due to beverage containers. This assumption implies that productivity is the same in both industries.

F.2.8 Other Industries

There are other industries associated with the production and sale of beverages and beverage containers. Some will be more affected than others by a proposal, but none of them will lose or gain substantial amounts of employment. The flavoring, extract, and syrups industry supplies flavors to the soft drink industry and might be affected directly by a change in the total consumption of soft drink. The vending industry might undergo changes if containerization changes. For example, cup machines might replace bottle and can machines if all bottles and cans have to carry a deposit. Suppliers of raw materials such as soda ash, sand, iron ore, coal, paper, and paint would also be affected if there is a change in containerization of beverages. But the absolute and relative impacts in these industries, however, will be substantially less than the industries studied more intensively above.

F.3 Occupations in the Beverage and the Beverage Container Industries

Employment changes differ within the occupational structures of the industries. These structures are outlined as eight broad occupational categories of employment within four industries: glass and glass products, primary metals, fabricated metals, and the beverage industry (see Table F-12).

The glass industry and both types of metal industries are likely to lose employment under proposals that have the effect of reducing the use of nonrefillable containers. The largest percentages of employment are in the categories of operatives, craftsmen, and professionals. The beverage industry is likely to gain some employment. It also has a large percentage of workers in the operatives category, and has higher percentages of sales workers and managers and lower percentages of craftsmen than do the glass and metal industries.

The occupational distribution in the beverage industry is not representative of the wholesale or retail industries for distributing beer. The most similar distribution would be those for wholesale and retail trade, but even these are not representative since wholesale distribution of beer would require many more drivers and delivery men than wholesale trade in general. Personnel handling empties at the retail store will probably be less skilled than the average for retail trade. There is no suitable information available on the occupational distribution for beer distribution or retail trade.

F.4 Personal Income

Employment changes due to changes in beverage containerization or consumption will cause income changes. The income losses will be temporary if, as is expected, displaced workers eventually find new jobs.

Several measures of personal income could be used to make these comparisons. One measure is the average hourly wage of production workers in each industry (see Table F-13). These wage rates, however, cover only the production workers and thus may not reflect the average earnings in the industry. In soft drinks, for example, production workers are only about one-third of total employment because distribution workers are so important. A better measure is average annual earnings which is derived

Table F-12. PROJECTED PERCENTAGE DISTRIBUTION OF INDUSTRY EMPLOYMENT BY OCCUPATION, 1975

Occupation	Glass and glass products	Primary metal	Fabricated metal products, n.e.c.	Beverage industries
Professional, technical, kindred	8.00	7.23	12.48	3.57
Engineers, technical	2.04	3.01	5.31	0.35
Natural scientists	0.28	0.39	0.61	0.53
Technicians, excl. medical, dental	1.81	1.74	3.10	0.81
Medical, other health workers	0.09	0.14	0.11	0.07
Teachers	0.00	0.02	0.03	0.00
Social scientists	0.11	0.10	0.08	0.04
Other prof., tech., & kindred	3.66	1.84	3.24	1.77
Manager, officials, proprietors	5.22	3.41	7.31	10.41
Clerical, & kindred workers	9.52	10.36	13.11	10.40
Stenos, typists, secretaries	2.57	2.47	3.81	2.48
Office machine operators	0.49	0.60	0.72	0.94
Other clerical, kindred	6.46	7.29	8.58	6.98
Sales workers	1.86	1.82	2.35	6.32
Craftsmen, foremen & kindred	16.29	31.68	23.57	16.52
Construction craftsmen	1.42	4.03	1.95	1.09
Foremen n.e.c.	5.72	6.07	5.13	5.32
Metalworking craftsmen, excl. mechanics	1.81	10.25	10.32	0.88
Printing trades craftsmen	0.13	0.03	0.17	0.03
Transport & Public utilities craftsmen	0.02	0.18	0.01	0.00
Mechanics & repairmen	4.61	4.43	3.66	5.46
Other craftsmen & kindred	2.59	6.69	2.34	3.75
Operative & kindred	51.87	33.60	36.53	43.16
Drivers & deliverymen	1.59	1.64	1.23	19.33
Transp. & pub. util. operatives	0.05	0.41	0.00	0.02
Semiskilled metalworking occup.	0.48	8.59	15.17	0.12
Semiskilled textile occup.	0.13	0.01	0.01	0.00
Other operatives & kindred	49.62	22.96	20.12	23.69
Service workers	2.08	1.85	1.45	2.09
Private household workers	0.00	0.00	0.00	0.00
Protective service workers	0.68	0.86	0.58	0.45
Food service workers	0.17	0.09	0.09	0.12
Laborers, except farm & mine	5.15	10.04	3.20	7.52
Total	100.00	100.00	100.00	100.00

Source: U.S. Bureau of Labor Statistics, Tomorrow's Manpower Needs, Vol. IV, "The National Industry Occupational Matrix and Other Manpower Data", Bulletin No. 1606. Washington, U.S. Government Printing Office, 1969, pp. 47,50,53, and 65.

n.e.c. = not elsewhere classified.

by dividing total payroll by total employment for the year (see Table F-14). Unfortunately, however, these data are not available for the nonmanufacturing industries for 1969. They are available for 1967 from the Census of Business and have been adjusted to 1969 using the proportional change found in all manufacturing industries. One additional drawback is that while the employment impacts in most of the affected industries will probably be across the board, for retailing almost all the new employees will probably earn lower wages than the average level of wages in retailing. However, this wage differential cannot be determined with any certainty and so the average earnings figure in retailing has been used.

These average earnings in Table F-14 were used to calculate the net effects on income of a change in container systems to the all-refillables system.

Table F-13. AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS IN THE BEVERAGE AND BEVERAGE CONTAINER INDUSTRIES, 1969

Industry	Hourly Rate	Yearly Rate*
Soft drink	$2.61	$5,220
Malt liquor	4.43	8,860
Wholesale beer distribution (misc. wholesale)	3.30	6,600
Glass containers	3.35	6,700
Metal cans	3.83	7,660
Metals (weighted steel and aluminum)	4.06	7,660
Retail grocery stores	2.58	5,160

Source: Employment and Earnings: United States, 1969-70, Bulletin 1312-7, U.S. Department of Labor, Bureau of Labor Statistics. Washington, Government Printing Office, n.d.

*Hourly rate multiplied by 2000, the average number of hours worked yearly.

Table F-14. ESTIMATED AVERAGE ANNUAL EARNINGS FOR ALL EMPLOYEES IN THE BEVERAGE AND BEVERAGE CONTAINER INDUSTRIES, 1969

Industry	Average annual earnings
Soft drink	6,486
Malt liquor	9,962
Wholesale beer distribution	7,858*
Glass containers	7,256
Metal cans	8,813
Metals	9,459
Retail grocery stores	5,801†

Source: 1967 Census of Manufactures; 1970 Annual Survey of Manufactures, U.S. Department of Commerce, Bureau of the Census.

*It is assumed that beer distribution keeps the same relationship to malt liquor in 1969 as in 1967.

†Grocery store average hourly wages were $2.58 in 1969. If the yearly earnings are proportional to hourly earnings and grocery stores are proportional to malt liquor, then average yearly earnings would be $5,801 in 1969.

Table F-15 contains the employment changes in seven beverage and beverage-related industries, the average earnings, and the total earnings associated with a shift to an all-refillables system. If consumption falls by 4 percent, there would be a decrease in income of approximately $114 million. The average employee under the present system earned $7,688 annually while the average employee under an all-refillables system would earn 4.5 percent less or $7,343; this is a difference of $345. The total income loss would be equal to 14,828 employees earning $7,688 annually.

While the $114 million loss in personal income is substantial, it will probably be offset by increases in other industries as consumers shift their purchases from beverages to other products in response to the price decreases of beverages. A multiplier could be attached to the income loss to calculate the total effect (including indirect effects) on the economy. There is little reason to do this, however, as we argue that the displaced employees will find new employment. Also if beverage

Table F-15. EMPLOYMENT AND EARNINGS IN SELECTED INDUSTRIES IN 1969 UNDER DIFFERENT CONTAINER SYSTEMS*

Industry	Present system		All-refillables system			
	1969 consumption		Same consumption		4% drop in consumption	
	Employment (thousands)	Earnings (millions)	Employment (thousands)	Earnings (millions)	Employment (thousands)	Earnings (millions)
Soft drink	128.6	$834.1	146.6	$950.8	141.2	$915.8
Malt liquor	58.1	578.8	63.2	629.6	61.3	610.7
Wholesale beer distribution	59.9	470.7	77.2	606.6	74.5	585.4
Glass containers	26.1	189.4	12.7	92.2	10.4	75.5
Metal cans	29.5	260.0	0	0	0	0
Metals	15.3	144.7	0	0	0	0
Retail grocery stores	19.6	113.8	52.1	302.2	50.0	290.1
Total	337.1	2,591.5	351.8	2,581.4	337.4	2,477.5
Average earnings per employee		$7,688.0		$7,338.0		$7,343.0

Source: Research Triangle Institute.

Note: Only employment and earnings directly derived from beverage and beverage containers are included in this table.

prices are lower, consumers will experience an income effect and spend the savings on other products thus generating more income.

The total income loss of $114 million is 4.4 percent of total earnings in these 7 industries. Furthermore, only the beverage container element of the last 4 industries is included in the calculations. If total employment in the glass container, metal can, metal, and retail grocery store industries were included, the percentage loss would be substantially less than 1 percent. If consumption remained constant, the income loss would only be $10.1 million or 0.4 percent of total earnings under the present system.

F.5 Reference

1. Corplan Associates of IIT Research Institute. A study of the soft drink industry 1965-70. Washington, American Bottlers of Carbonated Beverages, 1966. p. 23.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1972--759-912/3125 REGION NO. 5-II